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TEST PROGRAM. VOLUME 2 - THRUST CHAMBER
ASSEMBLIES. BOOK 2 - TWENTY-FIVE
POUND-THRUST OAMS TCA P/N 208160-61 FINAL
REPORT (Rocketdyne) 452 p

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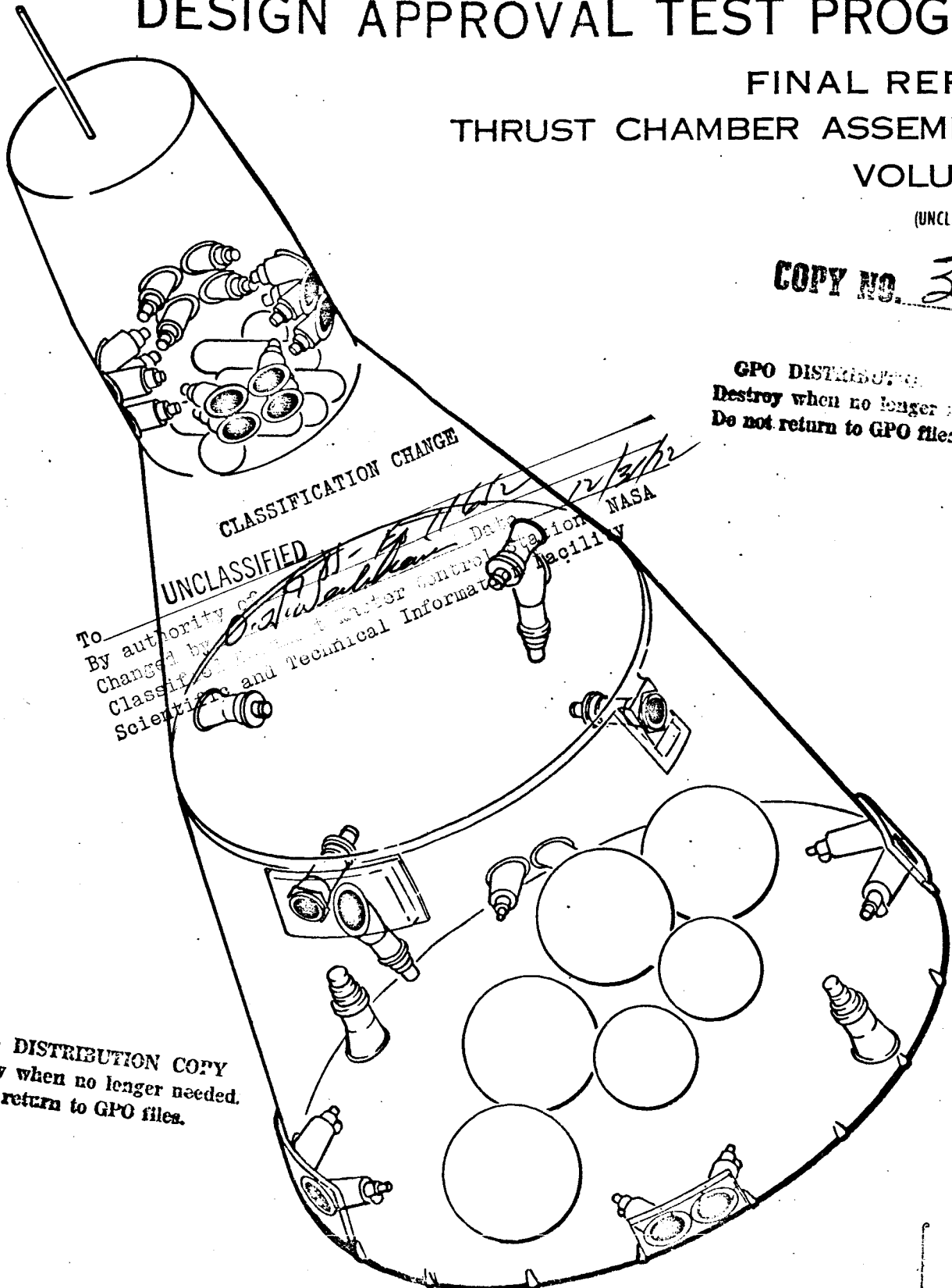
FINAL REPORT
THRUST CHAMBER ASSEMBLIES

VOLUME II

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R-15019-2

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GEMINI DESIGN APPROVAL TEST PROGRAM
FINAL REPORT, THRUST CHAMBER ASSEMBLIES
VOLUME II, BOOK 2
25-POUND-THRUST OAMS TCA
P/N 208160-61

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NO. OF PAGES 444 & viii

REVISIONS

DATE 7 October 1965

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FOREWORD

This report on the Design Approval Testing of the Gemini 25-pound-thrust OAMS thrust chamber assembly P/N 208160-61 was prepared for the McDonnell Aircraft Corporation in accordance with the requirements of Purchase Order Y20161R.

ABSTRACT

The Design Approval Test program conducted on the Gemini 25-pound-thrust OAMS thrust chamber assembly is described. Test data, photographs of test equipment, and test summaries are included.



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INTRODUCTION AND SUMMARY

The Design Approval Test program for the Gemini 25-pound-thrust, Orbit Attitude and Maneuver System (OAMS) Thrust Chamber Assembly (TCA) was conducted in compliance with McDonnell Aircraft Corporation Purchase Order Y20161R.

The objective of the Design Approval Test (DAT) program was to demonstrate compliance of the 25-pound-thrust OAMS TCA with the requirements of McDonnell Aircraft Corporation Specification Control Drawing 52-52701 by conducting a planned series of environmental and operating tests on three Thrust Chamber Assemblies. These TCA's were designated as Units 1, 2, and 3 for purposes of identification during the program.

Each of the three test units was subjected to all of the tests as required by the test specification and each demonstrated compliance with all test specification requirements except as indicated below.

During the Mission Duty Cycle tests conducted on Units 1 and 3, the throat station shell temperatures exceeded the specification limit of 550 F. These failures were reported in OFR (FAR) 12917R and OFR (FAR) 12954R (Appendix B), respectively. In no case was there any performance degradation or incipient mechanical failure observed. Each TCA successfully completed the Mission Duty Cycle test.

During the propellant resistance test conducted on the propellant valves from Unit 1, the oxidizer valve failed to open. This failure was reported in OFR (FAR) 12895R (Appendix B). Failure analysis revealed the failure was the result of a test facility electrical wiring problem and that the valve was operating properly.



During a facility checkout test conducted as part of the impulse-signal width test on Unit 2, the oxidizer valve opened approximately 15 milliseconds after the fuel valve opened. This failure was reported in OFR (FAR) 32656R (Appendix B). Failure analysis revealed corrosion and contamination of the oxidizer valve armature and bore as a result of inadequacies in the decontamination procedure. The decontamination procedure used during subsequent DAT TCA testing was revised to prevent a recurrence of this failure.

During the low-temperature (15 F) impulse-signal width test conducted on Unit 2, the oxidizer propellant valve failed to open. This failure was reported in OFR (FAR) 12924R (Appendix B). Failure analysis revealed the failure to have been caused by frozen propellant resulting from inadequately controlled environmental temperature. The test was subsequently satisfactorily completed on this unit.

A thorough evaluation of the performance characteristics of the 25-pound-thrust OAMS TCA was conducted prior to initiation of the DAT program and continued as additional data were generated during the program. The results of this evaluation indicated that the performance of the TCA did not conform to the specification requirements relative to the shutdown time requirement (7 milliseconds maximum from off signal to 2 percent of thrust) and the specific impulse requirement at the minimum impulse pulse (235 seconds minimum at a 0.25 lb-sec impulse).

As a result of this evaluation, Engineering Change Notice ECN-NA-SE7-289R1 was submitted to the customer by Rocketdyne recommending that the TCA shutdown requirement be changed from a maximum shutdown time to a maximum shutdown impulse and proposing a maximum shutdown impulse of 0.26 lb-sec. Shutdown impulse is the only significant measurable parameter which describes the shutdown performance of a TCA.



The recommendation relative to the revision of this requirement is incorporated in Appendix D of this DAT report. All pages reflecting this change are appropriately identified. Units 1, 2, and 3 all exhibited performance within this requirement.

The pulse specific impulse of this TCA as demonstrated during tests conducted prior to and during the DAT program does not conform to the specification requirements. However, the specification requires that the pulse specific impulse be demonstrated at the minimum impulse pulse (0.25 lb-sec). Operating the TCA in a pulse mode consisting of pulses of the magnitude of the minimum impulse pulse is not representative of the pulse mode operation anticipated during flight. Mission duty cycle test requirements for the 25-pound-thrust OAMS TCA (MAC MDC OCA-113), which represented the best estimate of expected TCA mission operating requirements, indicate that all of the required TCA pulses which provide an impulse of less than 1.0 lb-sec contribute only approximately 12 percent of the TCA MDC burn time to guaranteed life. The TCA specific impulse for the longer duration pulses is considerably higher than that for the shorter, 0.25 lb-sec impulse pulses, because of the geometry of the TCA injector and propellant valve to injector feed tubes. The electrical signal width-specific impulse characteristics for this TCA are as shown on page 357 (Appendix D). This TCA performance data was obtained using the most advanced instrumentation of this type available.

It is therefore concluded that compliance of the 25-pound-thrust OAMS Thrust Chamber Assembly with specification requirements was demonstrated to the extent necessary to satisfy mission objectives by the Design Approval Test program.



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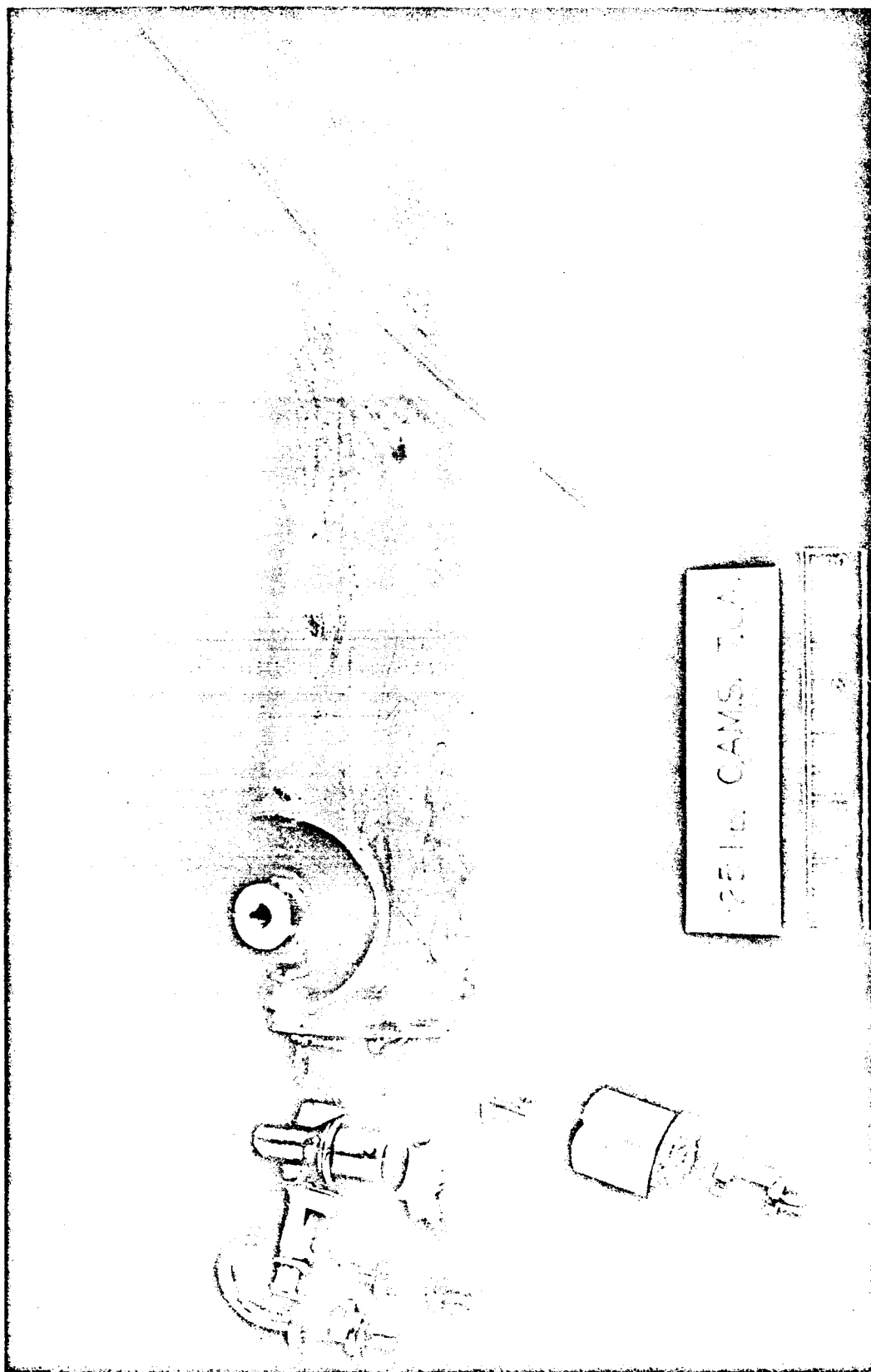


DESCRIPTION OF 25-POUND-THRUST OAMS THRUST
CHAMBER ASSEMBLY P/N 208160-61

The SE-7 25-pound-thrust Orbit Attitude and Maneuver System (OAMS) Thrust Chamber Assembly (TCA) is a storable liquid, bipropellant, pressure-fed, ablation-cooled assembly (Fig. 1 and 2). Eight TCA's of this configuration are used in the Orbit Attitude and Maneuver System for pitch, yaw, and roll control of the Gemini spacecraft while in earth orbit. Thrust level and propellant mixture ratio are controlled by fixed orifices located at the propellant valve inlets. The propellants used are nitrogen tetroxide (NTO) as the oxidizer and monomethylhydrazine (MMH) as the fuel.

The thrust chamber core is made in two segments: the combustion zone segment and the nozzle segment. The combustion zone segment is fabricated from 90-degree-oriented (perpendicular to the TCA centerline) resin-impregnated, high-silica ablative material. The nozzle segment is fabricated from zero-degree-oriented (parallel to the TCA centerline), resin-impregnated, high-silica ablative material. In addition, the thrust chamber core is wrapped with a layer of phenolic-bonded asbestos fiber to provide additional sealing capabilities. The bond line between the combustion chamber segment and the nozzle segment is located in a low-pressure, low-stress area aft of the throat insert.

Structural support for the thrust chamber body assembly is provided by layers of high-temperature, high-strength glass cloth and filament-wound glass roving bonded by phenolic resin. Additional layers of glass roving provide added strength in the injector attachment and throat areas. The combustion chamber of the TCA contains a seven-piece segmented JTA graphite liner "backed up" by a zero-degree ablative material sleeve. A throat



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Figure 1. 25-Pound-Thrust OAMS Thrust Chamber Assembly, P/N 208160-61

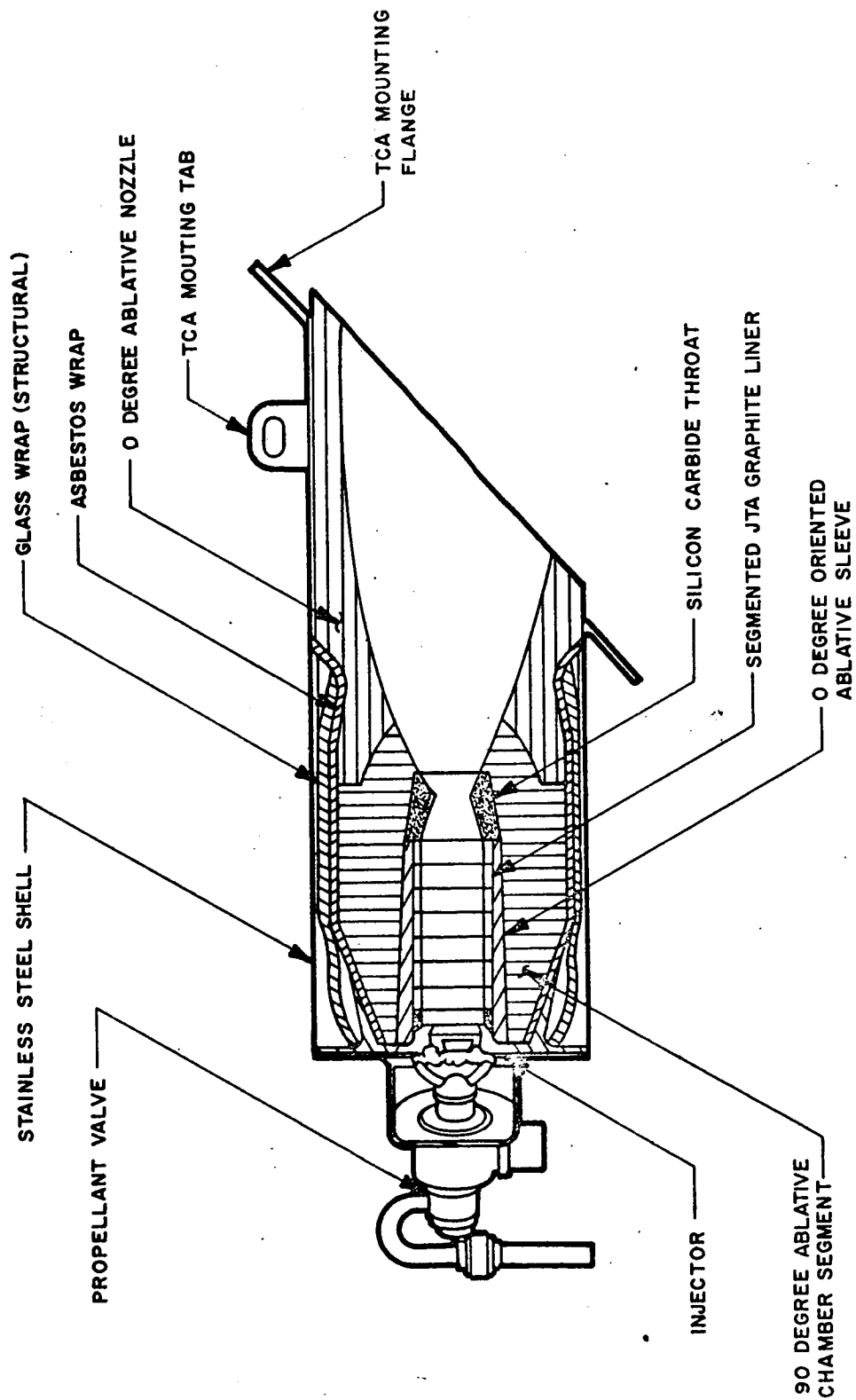


Figure 2. 25-Pound-Thrust OAMS TCA Schematic

insert of solid silicon carbide is used to resist the erosive effects of the high-temperature combustion gases. The thrust chamber body assembly is encased in a stainless-steel shell to provide structural attachment between the thrust chamber and the spacecraft.

The thrust chamber injector is fabricated from stainless steel. The injector incorporates four pairs of unlike doublets which impinge on a splash plate providing propellant mixing for high combustion efficiency.

TCA operation is controlled by two fast-acting, electrically operated, solenoid propellant valves (Fig. 3). These valves are attached to a mounting bracket which is in turn attached to the injector plate. The basic propellant valve design embodies a hermetically sealed solenoid. Valve sealing is accomplished through the use of a precision ground ball, attached to the armature, which engages a Teflon seat in the closed position. A metal stop below the Teflon seat is incorporated to limit the armature stroke. Closing is accomplished through the use of a spring, and sealing force is obtained from the spring and the pressure of propellant acting on the ball.

The physical and performance data for this TCA are presented in Table 1.

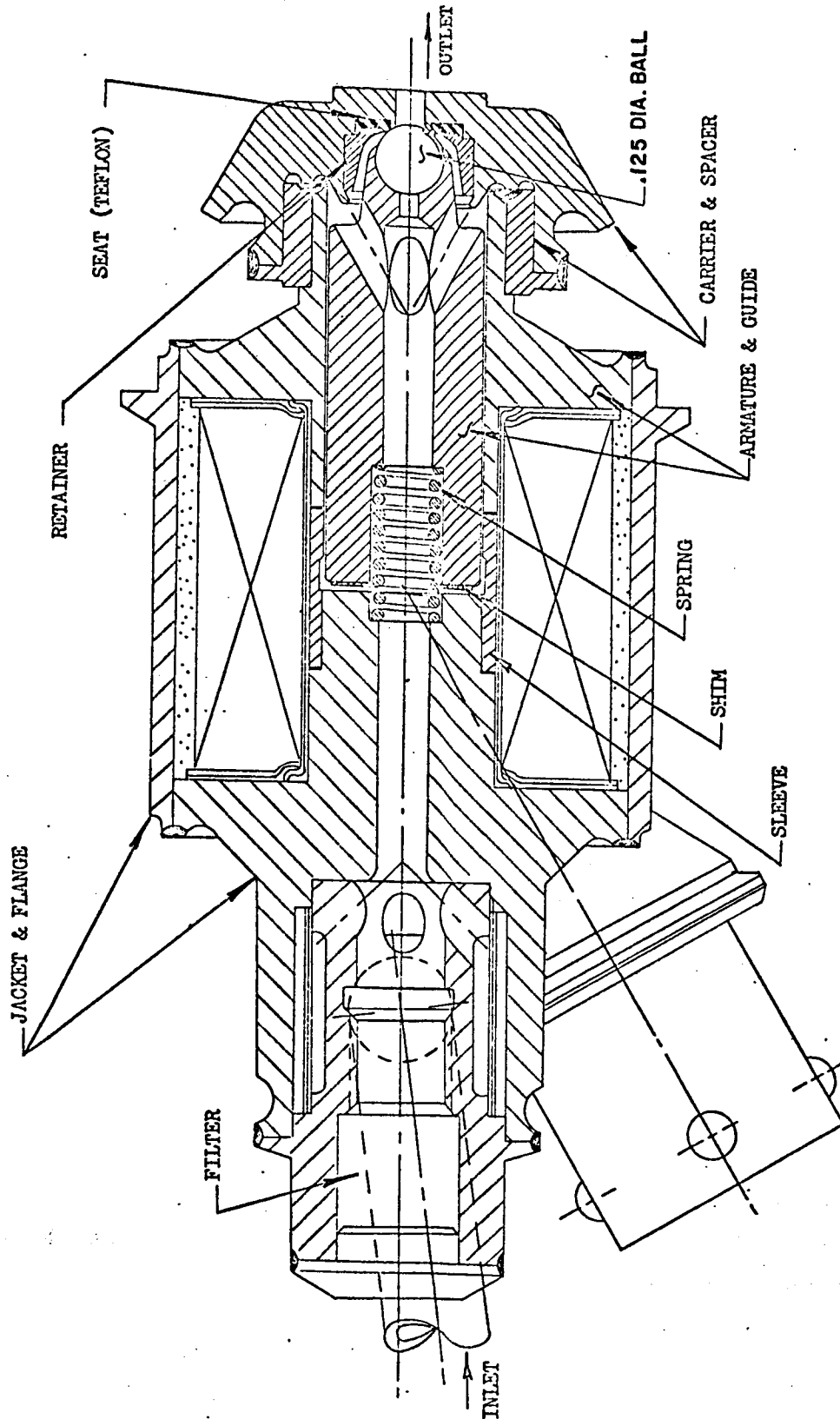


Figure 3. 25-Pound-Thrust OAMS TCA Propellant Valve Schematic



TABLE 1

25-POUND-THRUST OAMS TCA P/N 208160-61
PHYSICAL AND PERFORMANCE DATA

Compliance of the Gemini 25-pound-thrust OAMS TCA P/N 208160-61 with the following physical and performance requirements has been verified by design approval tests.

Physical Data

Envelope, inches

overall dimensions:
length 10.9,
forward OD 2.83, and
aft OD 2.83

Weight, Nominal, pounds

3.02

Compatibility

Nitrogen tetroxide and
monomethylhydrazineMaterials

Valve parts, Internal Exposed

CRES and Teflon

Injector

Type 321 CRES

Thrust Chamber Core

Ablative and ceramic

Structural Shell and Brackets

Type 321 CRES

Performance Data

Propellants

nitrogen tetroxide
(oxidizer) and
monomethylhydrazine (fuel)

Thrust, Vacuum, Rated, pounds

23.0

Chamber Pressure, Nominal, psia

132

Mixture Ratio, Rated, o/f

1.30

Specific Impulse

Classified (see page 11)

Start time, Maximum, milliseconds

25

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TABLE I

(Continued)

Performance

Specific Impulse, Nominal, seconds* 259

*Classified Parameter~~CONFIDENTIAL~~



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TABLE 1
(Concluded)Performance Data

Shutdown Impulse, Maximum, lb-sec	0.260
Oxidizer Inlet Pressure, Rated, psia	292
Fuel Inlet Pressure, Rated, psia	292
Life, Specification Performance, MAC Mission Duty Cycle OCA 113, seconds	118
Life, Guaranteed MAC Mission Duty Cycle OCA 113, seconds	160
Propellant Valve Service Life, Cycles 1	50,000
Propellant Valve Voltage, Nominal, vdc	26.0
Propellant Valve Current, Nominal, amps	0.619
Environmental Temperature Range, Operating, F	15 to 200
Environmental Temperature Shock Range, Nonoperating, F	-40 F to +185
Vibration Level Random, g	7.5
Shock Level (in shipping container), g	15 for 11 milliseconds
Proof Pressure, psig	392

- (1) This requirement was verified using a 25-pound-thrust RCS DAT TCA as reported in Rocketdyne Report R-15019-2, Volume II, Book 1



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TEST PROGRAM

TEST SEQUENCE

TCA Units 1, 2, and 3 were subjected to the tests outlined below in the order listed.

Unit 1

1. Visual Inspection
 - a. Component Modification
2. Vibration Test
 - a. Propellant Valve Proof Pressure and Leakage
 - b. Thrust Chamber Proof Pressure and Leakage
 - c. Propellant Valve Electrical Resistance
 - d. Propellant Valve Dielectric Strength
 - e. Propellant Valve Functional
3. Mechanical Shock Test
 - a. Propellant Valve Proof Pressure and Leakage
 - b. Thrust Chamber Proof Pressure and Leakage
 - c. Propellant Valve Electrical Resistance
 - d. Propellant Valve Dielectric Strength
 - e. Propellant Valve Functional
4. Mission Duty Cycle to Failure Test
5. Disassembly and Inspection (Thrust Chamber Only)
6. Explosive Atmosphere Test (Propellant Valves Only)
 - a. Propellant Valve Proof Pressure and Leakage
 - b. Propellant Valve Electrical Resistance
 - c. Propellant Valve Dielectric Strength
 - d. Propellant Valve Functional



7. Fuel and Oxidizer Resistance Test (Propellant Valves Only)
 - a. Propellant Valve Electrical Resistance
 - b. Propellant Valve Functional
 - c. Propellant Valve Dielectric Strength
 - d. Propellant Valve Proof Pressure and Leakage
 - e. Propellant Valve Load Analysis
8. Disassembly and Inspection (Propellant Valves Only)

Unit 2

1. Visual Inspection
 - a. Component Modification
2. Temperature Shock Test
 - a. Propellant Valve Proof Pressure and Leakage
 - b. Thrust Chamber Proof Pressure and Leakage
 - c. Propellant Valve Electrical Resistance
 - d. Propellant Valve Dielectric Strength
 - e. Propellant Valve Functional
3. Impulse-Signal Width Test
4. Mission Duty Cycle to Guaranteed Life Test (160 Seconds)
5. Disassembly and Inspection

Unit 3

1. Visual Inspection
 - a. Component Modification



2. Mission Duty Cycle to In-Specification Life (118 Seconds) and Hot-Fire Burst Pressure Test
3. Disassembly and Inspection

TEST UNIT IDENTIFICATION P/N 208160-61

1. Unit 1, S/N 4058233
2. Unit 2, S/N 4058232
3. Unit 3, S/N 4057532

TEST DESCRIPTION AND RESULTS, UNIT 1

VISUAL INSPECTION

Description

Unit 1 was inspected to ensure that it was of the proper configuration, was undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-354.

Following the visual inspection, Unit 1 was modified by the addition of simulated spacecraft system tube extensions (P/N 99-106694 and P/N 99-106695) to the existing fuel and oxidizer inlet tube stubs. Installation of the tube extensions was accomplished per Rocketdyne Specification RA0607-009, "In Place Brazing of Tubes and Fittings for Space Engines."

Results

The visual inspection was successfully completed.



VIBRATION TEST

Description

Unit 1 was subjected to random vibration testing along each of the three mutually perpendicular axes. The random vibration time for each axis was 8 minutes less the equalization time required to verify spectrum shape and tolerance. The maximum-allowable equalization time was 20 percent of the vibration time for each axis.

Prior to the start of the random vibration testing in each axis, a sine-wave survey (1-g maximum peak, logarithmic sweep from 5 to 2000 cps in 5 minutes) was conducted to calibrate the input and output accelerometers.

During the vibration test, the TCA was mounted in MAC-supplied spacecraft bracketry, which in turn was mounted in a rigid test fixture.

The random vibration test was at an overall equivalent level of 7.5 g rms. The vibration frequency was varied from 20 to 2000 cps. The vibration spectrum was as follows:

1. 0.02 to $0.12 \text{ g}^2/\text{cps}$ from 20 to 100 cps
2. $0.2 \text{ g}^2/\text{cps}$ from 100 to 300 cps
3. 0.12 to $0.01 \text{ g}^2/\text{cps}$ from 300 to 600 cps
4. $0.01 \text{ g}^2/\text{cps}$ from 600 to 2000 cps

Propellant valve leakage and functional tests and thrust chamber proof-pressure and leakage tests were conducted following the completion of the vibration testing.



Results

The vibration test was successfully completed.

MECHANICAL SHOCK TEST

In preparation for the mechanical shock test on Unit 1, the simulated spacecraft system tube extensions were replaced by inlet tube adapters (P/N 99-106126-11). Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Description

Unit 1 was installed in a standard Rocketdyne shipping container and was subjected to three shocks in each direction along each of the three mutually perpendicular axes for a total of 18 shocks. The shocks were of 15 g magnitude and 11-millisecond duration.

Following the mechanical shock testing, propellant valve leakage and functional tests and thrust chamber proof pressure and leakage tests were conducted.

Results

The mechanical shock test was successfully completed.



MISSION DUTY CYCLE TO FAILURE TEST

Description

Unit 1 was installed in the hot-fire test facility and was subjected to a Mission Duty Cycle Test (MAC MDC OCA-113) to failure. The first portion of the MDC was a "cape firing cycle" conducted at local ambient temperature and pressure, after which the TCA was allowed to return to local ambient temperature. The second portion of the MDC consisted of operating the TCA as described in Table II, page 428 (Appendix D) to failure. This MDC was conducted at a simulated altitude in excess of 100,000 feet and at local ambient temperature.

Results

The Mission Duty Cycle to failure test was successfully completed; however, the TCA shell temperatures exceeded the specification limit of 550 F by 50 F after 118 seconds of mission duty cycle burn time. The test was continued because it was believed that the MDC test results and the subsequent shell temperature failure analysis would not be comprised. This judgement was verified by the test results. The TCA completed the MDC with no performance degradation or incipient mechanical failure. The failure was reported in OFR (FAR) 12917R (Appendix B).



EXPLOSIVE ATMOSPHERE TEST

Description

The propellant valves were removed from Unit 1, installed in special test fixtures, placed in an explosive atmosphere test chamber, and exposed to an environmental temperature of 160 F. A potentially explosive atmosphere was created in the test chamber by the introduction of a butane gas-air, mixture. The valves were then actuated at several simulated pressure altitudes between sea level and 50,000 feet. For each required pressure altitude, the valves were actuated as follows: ten actuations at a pressure altitude 5000 feet above the required level, then one actuation at each of 10 equally spaced pressure altitudes down to 5000 feet below the required pressure altitude except at sea level (no tests were conducted at pressure altitudes below sea level). The valves were energized with 26 vdc for 10 seconds during each actuation to demonstrate the ability to actuate without igniting the explosive atmosphere. Prior to the first and after the final actuation, a sample of gas from the chamber was removed and spark ignited to demonstrate combustibility. Prior to and following the explosive atmosphere test, propellant valve leakage and functional tests were performed.

Results

The explosive atmosphere test was successfully completed.



FUEL AND OXIDIZER RESISTANCE TEST

Description

The propellant valves were installed in special test fixtures, installed in the propellant resistance test facility, filled with the respective propellants [fuel (MMH) and oxidizer (NTO)] and temperature conditioned to 160 F. The valves were then to be exposed to propellant for a period of 2 weeks (336 hours). During this time, the valves were to have been actuated three times daily at equally spaced intervals with oscillograph recordings being made to verify proper valve operation. Leakage and functional tests were conducted on the valves following the propellant exposure period.

Results

After the fuel valve had been exposed to propellant for 1-1/2 days, a leak was noted in the test facility propellant system. This leak was found to be caused by the use of a noncompatible seal. Since this presented the possibility of contamination of the valve, the valve was removed, flushed, and functionally tested, the test facility was equipped with the proper seals, and the propellant exposure test was restarted with test exposure time reverting to zero as authorized by Rocketdyne Internal Letter 4388-5219 (page 292, Appendix D). The fuel resistance test was then successfully completed.

After the oxidizer valve had been exposed to propellant for 1-1/2 days, the valve failed to open during a scheduled actuation. This failure was reported to OFR (FAR) 12895R (Appendix B). During a subsequent functional



test conducted as part of the failure analysis, the valve operated normally. The test facility electrical wiring was then checked and was found to have a short circuit which prevented the electrical signal from reaching the propellant valve. Propellant valve functional tests were then performed to verify normal operation, the facility was repaired, and the propellant exposure test was restarted with test exposure time reverting to zero, as authorized by Rocketdyne Internal Letter 4388-5239 (page 295, Appendix D). The oxidizer resistance test was then successfully completed.

DISASSEMBLY AND INSPECTION

Description

Unit 1 was visually inspected for any defects, damage, or abnormal wear. The disassembly consisted of: (1) sectioning the propellant valves at the fabrication welds, (2) disassembly of the propellant valve internal parts, and (3) sectioning the thrust chamber body. The propellant valve parts and thrust chamber sections were visually inspected to determine the internal condition. A record was made of the pertinent items. Following the normal disassembly and inspection, the thrust chamber body was sectioned into quarter segments for further study as authorized by Rocketdyne Internal Letter 4388-5234 (page 258, Appendix D).

Results

The predisassembly inspection of Unit 1 revealed slight ablative material separation in the nozzle. The postdisassembly inspection revealed ablative material separation in the combustion zone and that the char front extended into the asbestos tape wrap.



TEST DESCRIPTION AND RESULTS, UNIT 2

VISUAL INSPECTION

Description

Unit 2 was inspected to ensure that it was of the proper configuration, was undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-354.

Following the visual inspection, Unit 2 was modified by the addition of propellant valve inlet tube adapters (P/N 99-106126-11) to the existing oxidizer and fuel inlet tube stubs. Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009; "In-Place Brazing of Tubes and Fittings for Space Engine."

Results

Visual inspection was successfully completed.

TEMPERATURE SHOCK TEST

Description

Unit 2 was placed in a temperature-controlled chamber and exposed to a temperature of 185 F for a period of 4 hours. It was then transferred, within 5 minutes, to a second temperature-controlled chamber where it was exposed to a temperature of -40 F for 4 hours. This was repeated



until a total of three heating and three cooling cycles were accumulated. The TCA was then allowed to return to room temperature and within 1 hour thereafter was subjected to propellant valve leakage and functional tests and a thrust chamber proof pressure and leakage test.

Results

The temperature shock test was successfully completed.

IMPULSE-SIGNAL WIDTH TEST

Description

Unit 2 was installed in the hot-fire test facility and was subjected to an impulse-signal width test series. The tests in this series were conducted at a simulated pressure altitude in excess of 100,000 feet and environmental temperatures as indicated below. The first portion of the series consisted of pulse-width survey tests consisting of 20 pulses each at electrical signal durations of 11, 15, 20, 30, 50, and 100 milliseconds. The pulse period in each case was a minimum of 3 seconds. A 2.5-second steady-state test for performance verification followed the pulses. The data were then reduced to determine the electrical signal width required for an impulse bit of 0.25 lb-sec total impulse.

The second portion of the series consisted of pulse repeatability tests. These tests were to be conducted with the propellants and the TCA injector conditioned to temperatures of local ambient, 160 F, and 20 F.



The pulse-repeatability test conducted at each temperature consisted of 20 pulses each using propellant valve control voltages of 22, 26, and 30 vdc, and the pulse-signal width determined by the pulse-width survey tests. The pulse period in each case was a minimum of 3 seconds. In addition, along with each pulse repeatability test at each temperature, a 2.5-second steady-state firing was to be conducted to verify TCA performance and satisfactory instrumentation operation.

Results

The first attempt to conduct the pulse-width survey tests was terminated as a result of problems encountered with the test facility propellant feed systems. Following correction of the test facility problem, the pulse-width survey tests were repeated as authorized by Rocketdyne Internal Letter 4388-5299 (page 343, Appendix D).

The second attempt at the pulse-width survey tests was terminated as the result of a propellant valve electrical control system problem. The pulse-width survey tests were repeated again after correcting the electrical control system problem and were then successfully completed. The ambient temperature pulse repeatability test was also successfully completed.

The first attempt to conduct the hot mode pulse repeatability test was terminated as a result of problems encountered with the test facility environmental temperature conditioning system. Prior to the second attempt to conduct the hot mode repeatability test, a test facility verification test was conducted as authorized by Rocketdyne Internal Letter 4388-5309 (page 341, Appendix D). The oxidizer valve opened slowly on



the first pulse of this test. This failure was reported in OFR (FAR) 32656R (Appendix B). Subsequent timing checks conducted as a part of the failure analysis indicated that the valve was operating properly. The unit was then resubmitted to the hot mode pulse repeatability test as authorized by Rocketdyne Internal Letter 5388-626 (page 349 , Appendix D). The hot mode pulse repeatability test was successfully completed.

The first two attempts to conduct the cold mode pulse repeatability test were terminated because of test facility environmental temperature conditioning system problems resulting in freezing of the oxidizer. Prior to the third attempt, the DAT specification was revised to change the cold mode temperature requirement from $15 \begin{smallmatrix} +5 \\ -0 \end{smallmatrix}$ F to 20 ± 5 F. During the third attempt to conduct the cold mode pulse repeatability test the oxidizer valve operated sluggishly. This failure was reported in OFR (FAR) 12924R (Appendix B). This failure was also traced to problems with test facility temperature conditioning system. Prior to the fourth attempt to conduct the test, the temperature conditioning system was modified to improve the temperature control capabilities. The cold mode pulse repeatability test was then successfully completed.

MISSION DUTY CYCLE TO GUARANTEED LIFE TEST (160 SECONDS)

Description

Unit 2 was installed in the hot-fire test facility and was subjected to a Mission Duty Cycle test to guaranteed life (MAC MDC OCA-113) (160 seconds). The first portion of the MDC consisted of a "cape firing cycle" conducted at local ambient pressure and temperature conditions after which the TCA was allowed to return to local ambient temperature. The second portion of the test consisted of operating the TCA as described in Table II, page 428 (Appendix D), up to 160 seconds of burn time.



Results

The mission duty cycle test to guaranteed life test was successfully completed.

DISASSEMBLY AND INSPECTION

Description

Unit 2 was visually inspected for any defects, damage, or abnormal wear. The disassembly consisted of: (1) removal of the propellant valves, (2) sectioning the propellant valves at the fabrication welds, (3) disassembly of the propellant valve internal parts, and (4) sectioning the thrust chamber body. A record was made of the pertinent items.

Results

The predisassembly inspection of Unit 2 revealed the following: (1) ablative material separation in the nozzle approximately 1 inch downstream of the throat insert, and (2) the first JTA graphite liner segment upstream of the throat was cracked two places.

The postdisassembly inspection revealed: (1) ablative material separation in the combustion zone, (2) three cracks in the throat insert, and (3) ablative material delaminations in the nozzle.



TEST DESCRIPTION AND RESULTS, UNIT 3

VISUAL INSPECTION TEST

Description

Unit 3 was inspected to ensure that it was of the proper configuration, was undamaged, and had been subjected to and passed an acceptance test per Rocketdyne Specification RA0220-354.

The unit was then modified by the installation of propellant valve inlet adapters (P/N 99-106126-11) to the existing fuel and oxidizer inlet tube stubs. Installation of the adapters was accomplished per Rocketdyne Specification RA0607-009, "In-Place Brazing of Tubes and Fittings for Space Engines."

Results

The visual inspection was successfully completed.

MISSION DUTY CYCLE TO IN SPECIFICATION LIFE (118 SECONDS) AND HOT-FIRE BURST PRESSURE TEST

Description

Prior to the mission duty cycle test, Unit 3 was reworked by removing the propellant metering orifices. The Unit was then installed in the hot-fire test facility, and the propellant metering orifices were installed in the test facility propellant feed systems so that the propellant could be allowed to flow through the orifices during the MDC test and later bypass the orifices during the hot-fire burst pressure test.



The first portion of the MDC was a "cape firing cycle" conducted at local ambient pressure and temperature, after which the TCA was allowed to return to local ambient temperature. The second portion of the MDC consisted of operating the TCA as described in Table II, (page 428 Appendix D) up to 117 seconds of burn time.

During the temperature "soakout" period following the MDC, the propellant tank pressures were raised to 750 psig and the orifice bypass valves were opened. After all TCA shell temperatures had peaked and dropped 5 F, a 3-second steady-state burst pressure test was conducted.

Results

The MDC to in specification life and hot-fire burst pressure test was successfully completed; however, the throat station shell temperature exceeded the allowable temperature of 550 F by 100 F after 118 seconds of burn time. The test was continued because it was believed that the test results and the subsequent shell temperature failure analysis would not be compromised. This judgement was verified by the test results. This failure was reported in OFR (FAR) 12954 (Appendix B).

A chamber pressure of 320 psia was obtained during the hot-fire burst pressure test.

DISASSEMBLY AND INSPECTION

Description

Unit 3 was visually inspected for any defects, damage, or abnormal wear. A record was made of pertinent items of condition visible prior to



disassembly. The disassembly consisted of: (1) removal of the propellant valves, (2) sectioning the propellant valves at the fabrication welds, (3) disassembly of the propellant valve internal parts, and (4) sectioning the throat chamber body. The propellant valve parts and chamber sections were visually inspected to determine internal condition. A record was made of the pertinent items.

Results

The predisassembly inspection of Unit 3 revealed the following: (1) delaminations of the nozzle ablative material, (2) thermal discoloration of the stainless-steel shell, and (3) erosion of the throat and combustion zone liners.

The postdisassembly inspection revealed: (1) delaminations of the combustion zone ablative material, (2) a 360-degree circumferential crack in the throat insert, and (3) the ablative material in the combustion zone was charred out to the asbestos tape wrap.



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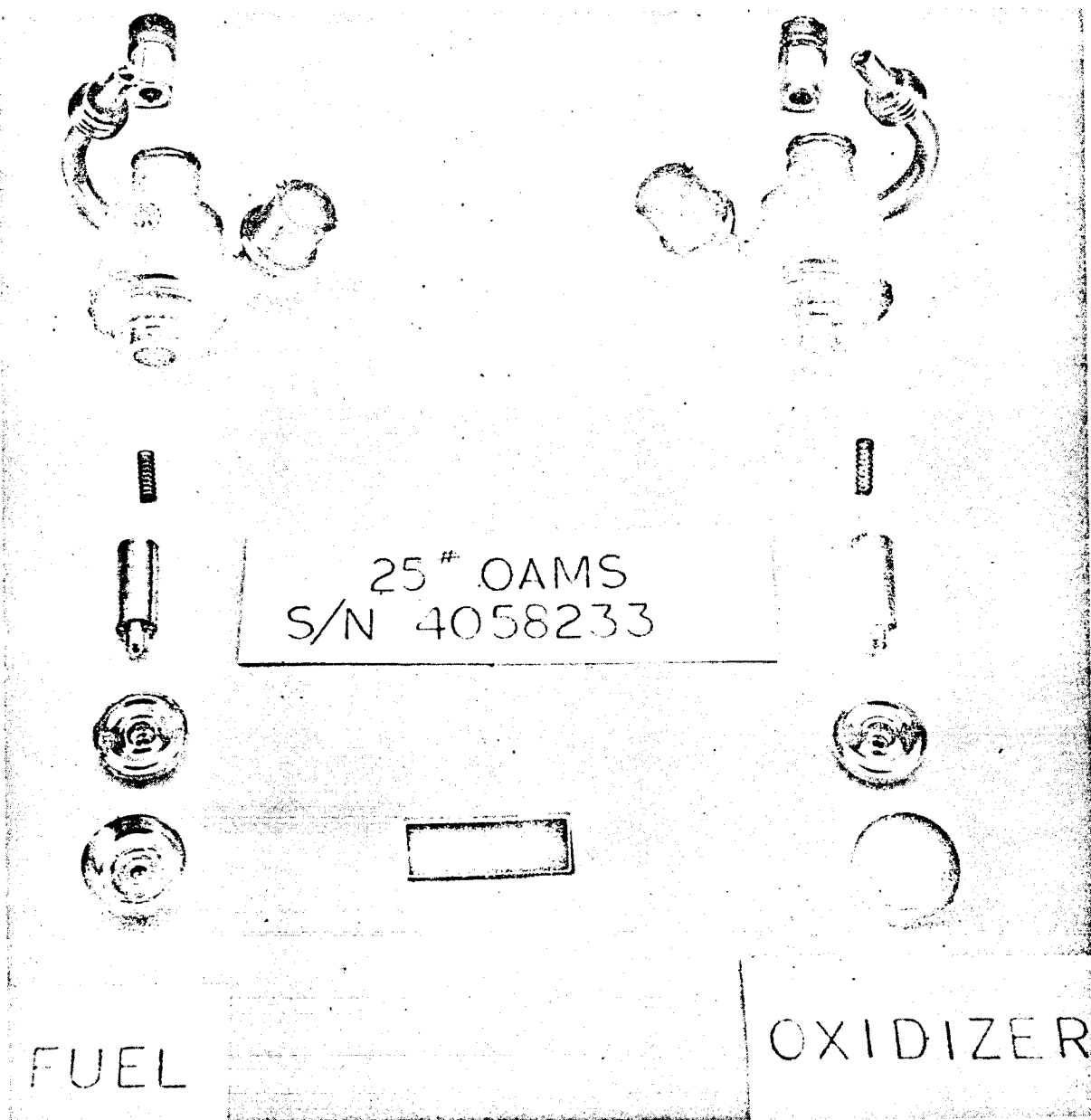
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APPENDIX A



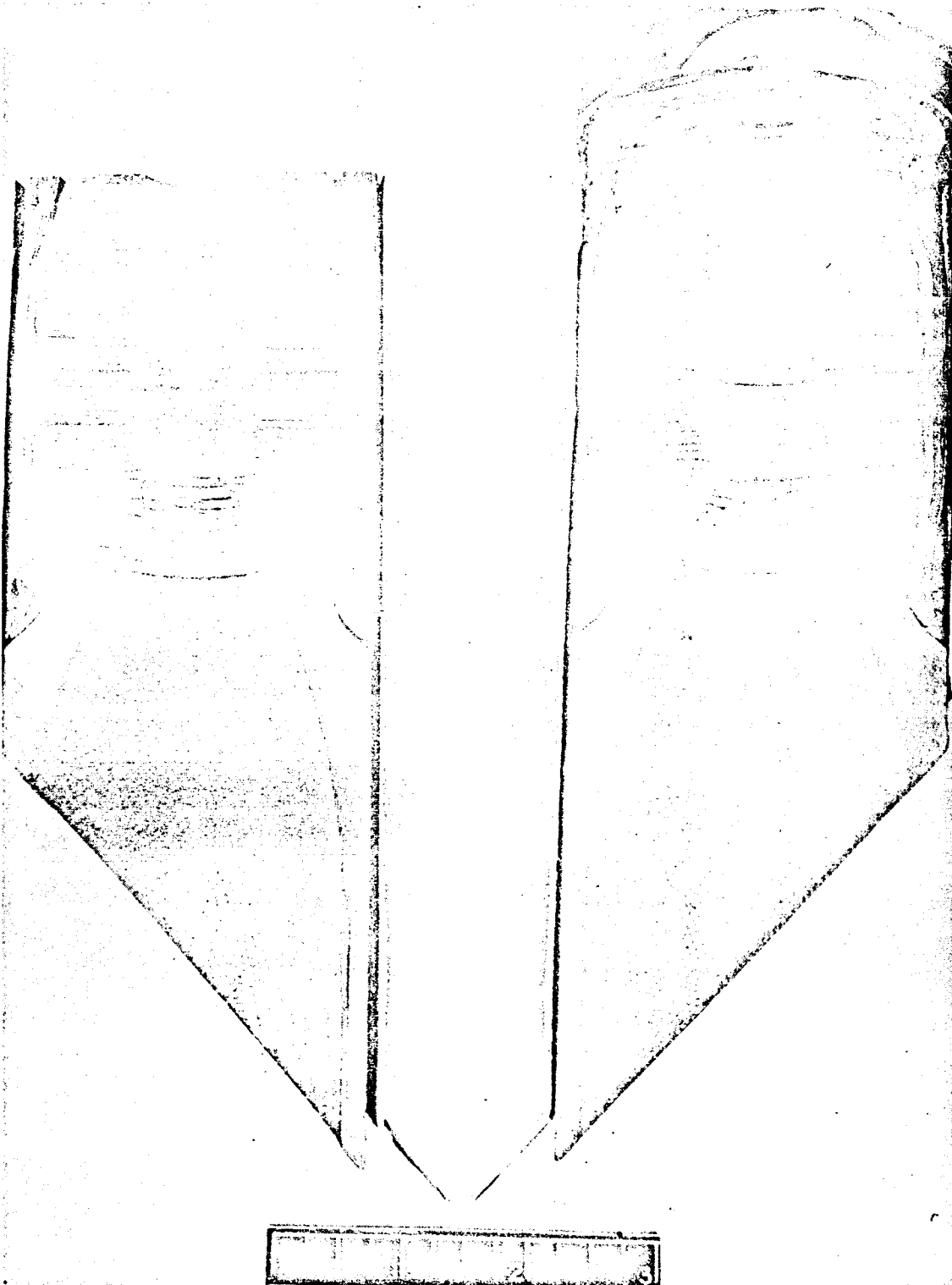
APPENDIX A

PHOTOGRAPHS OF TESTS AND TEST EQUIPMENT



1HE65-7/23/65-C1

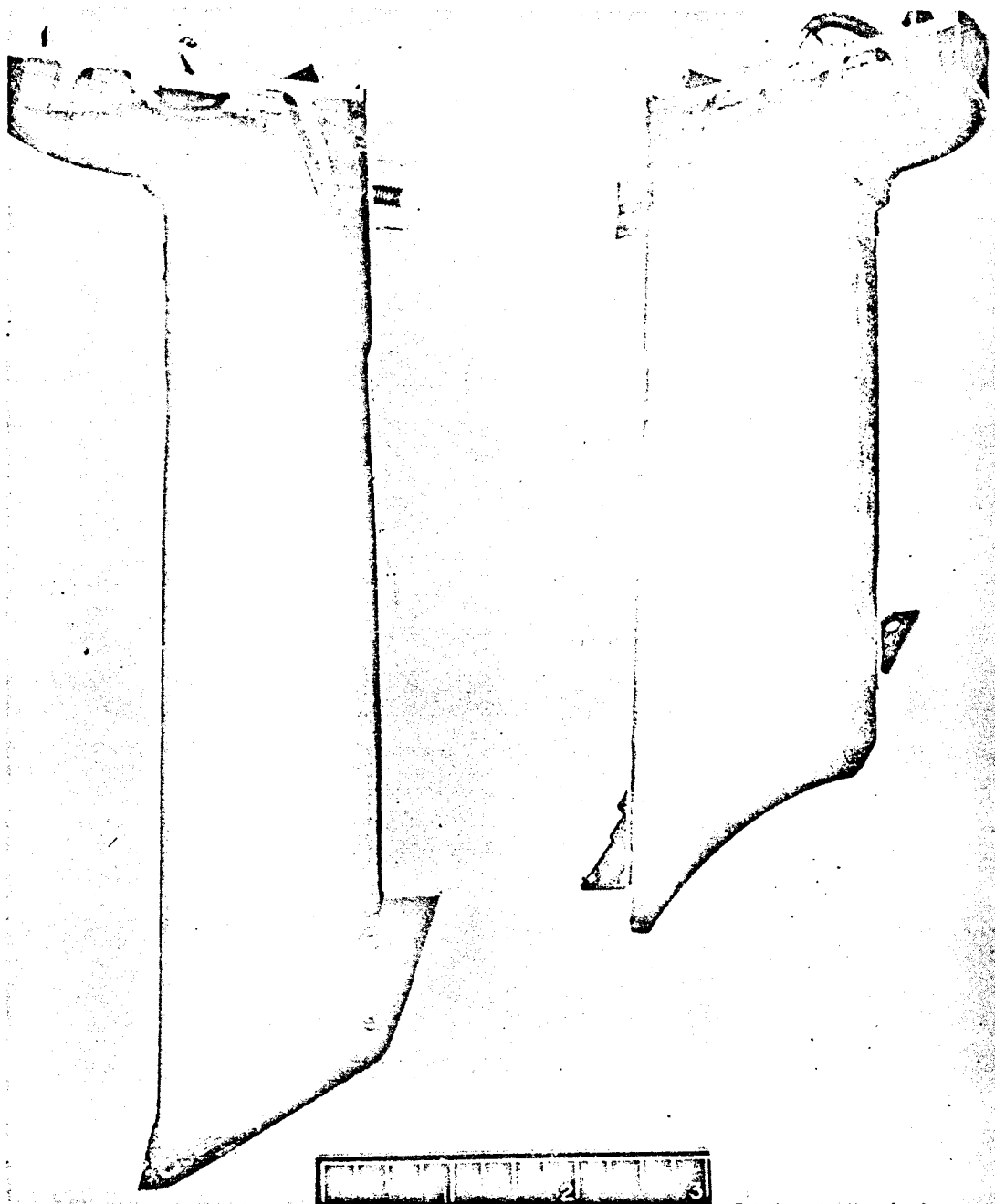
Figure 4 . 25-Pound- Thrust OAMS TCA DAT Unit 1 Propellant Valves
Disassembly and Inspection



1HE35-11/25/64-C1A

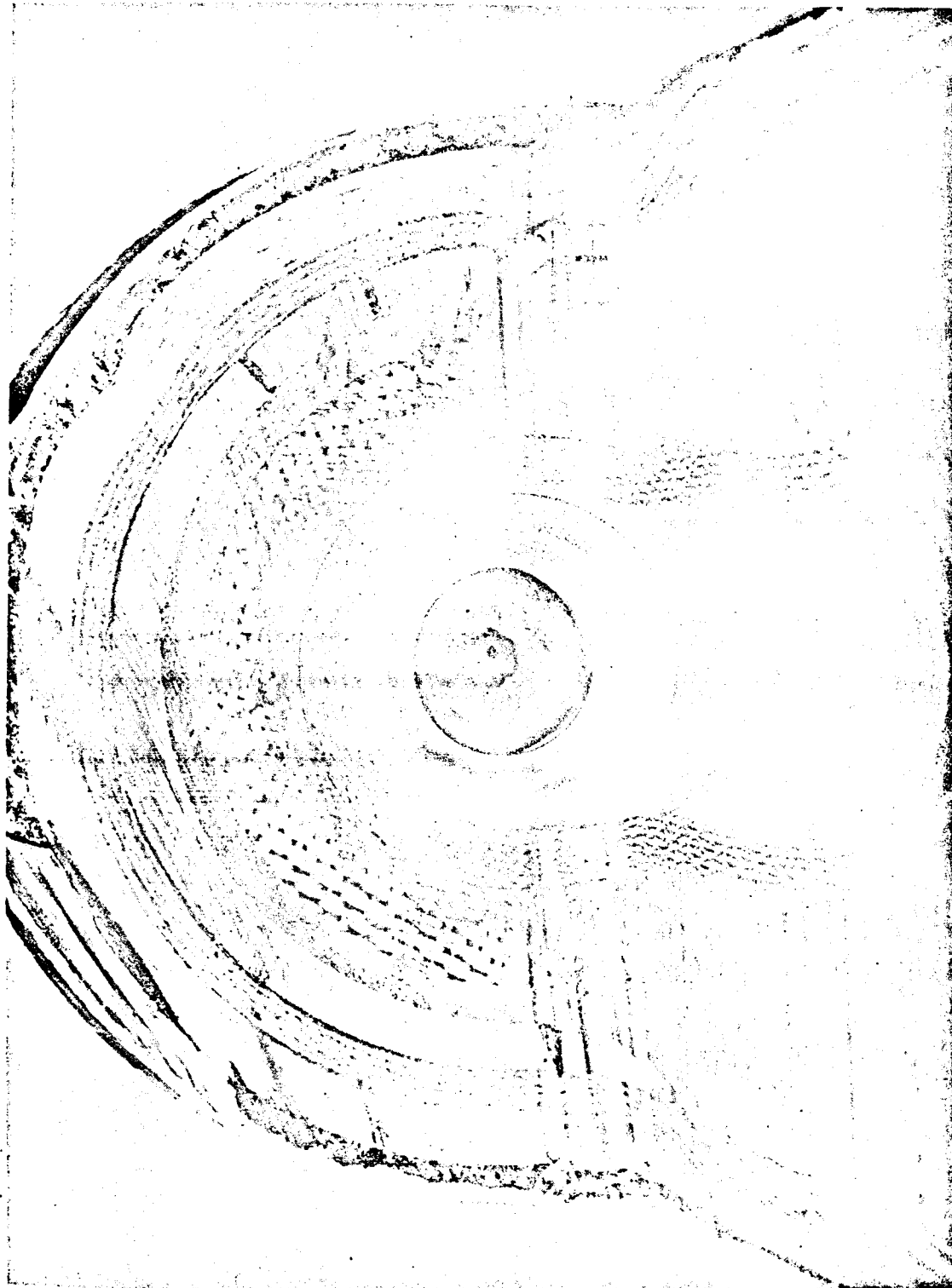
Figure 5. 25-Pound-Thrust OAMS TCA DAT Unit 1 Disassembly
and Inspection Post-MDC to Failure Test (View 1)

R-15019-2



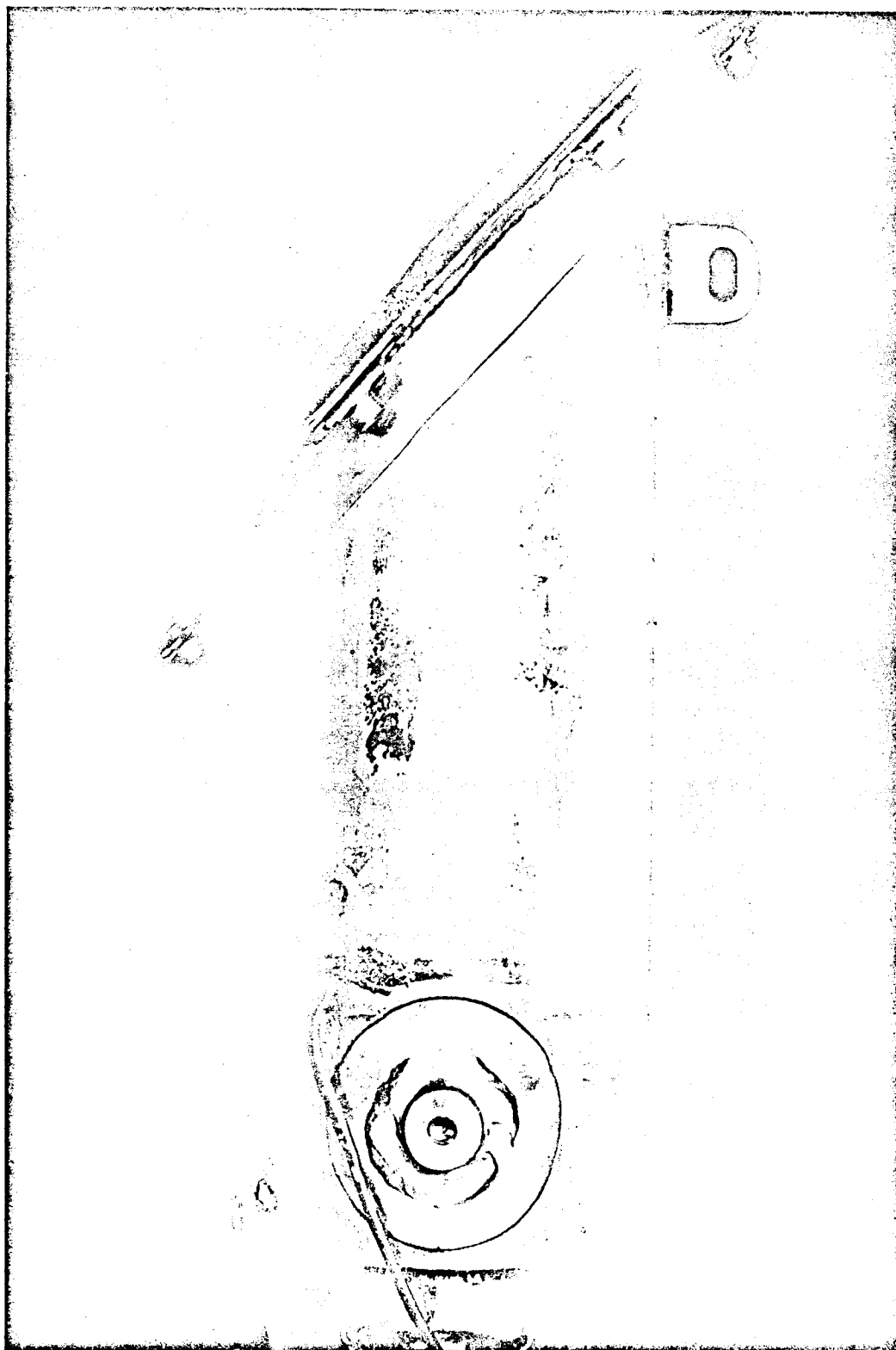
1HE35-12/4/64-C2

Figure 6 . 25-Pound-Thrust OAMS TCA DAT Unit Disassembly
and Inspection Post-MDC to Failure Test (View 2)

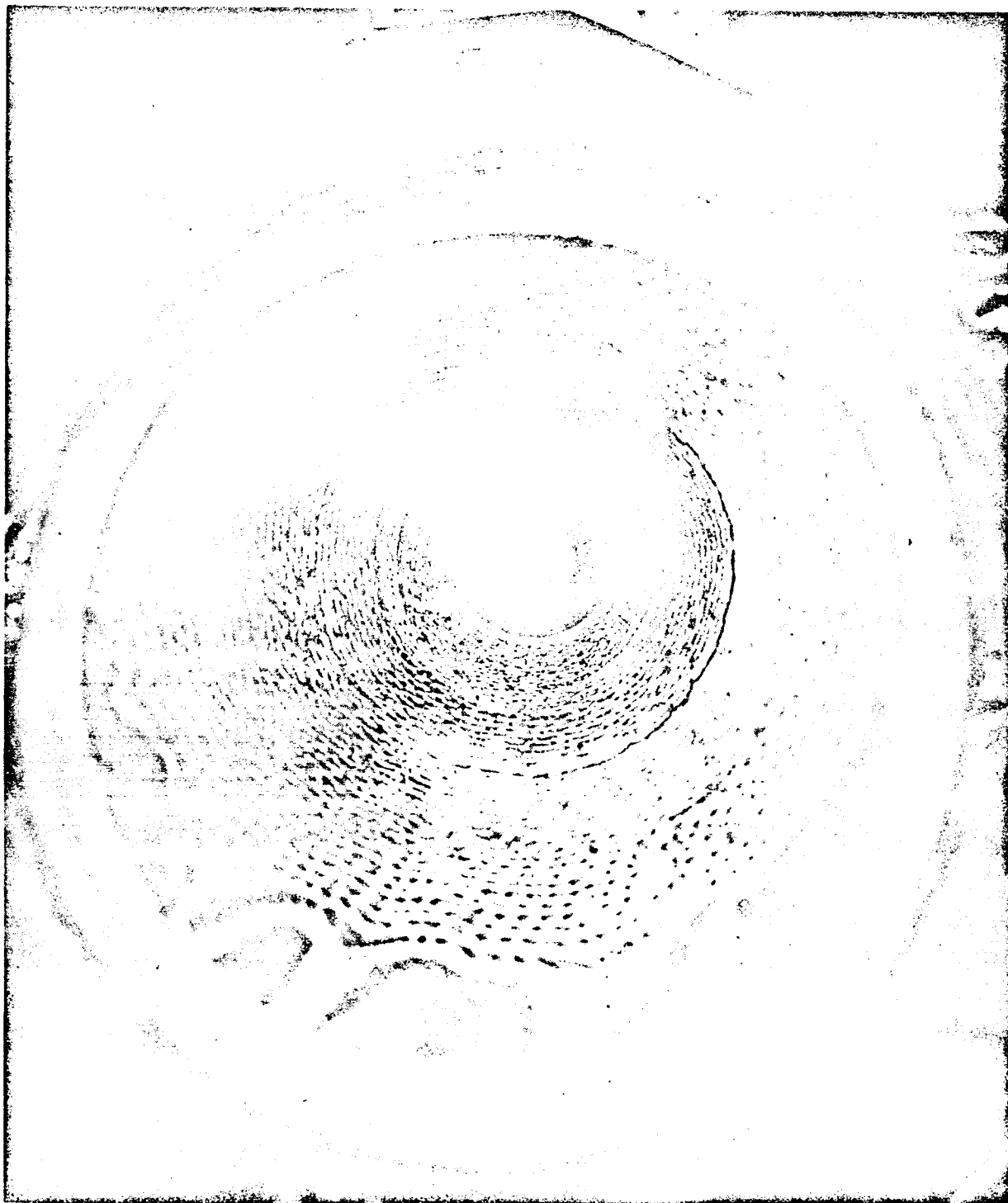


IHE35-11/25/64-CIB

Figure 7. 25-Pound-Thrust OAMS TCA DAT Unit 1 Disassembly and Inspection
Post-MDC to Failure Test (View 3)

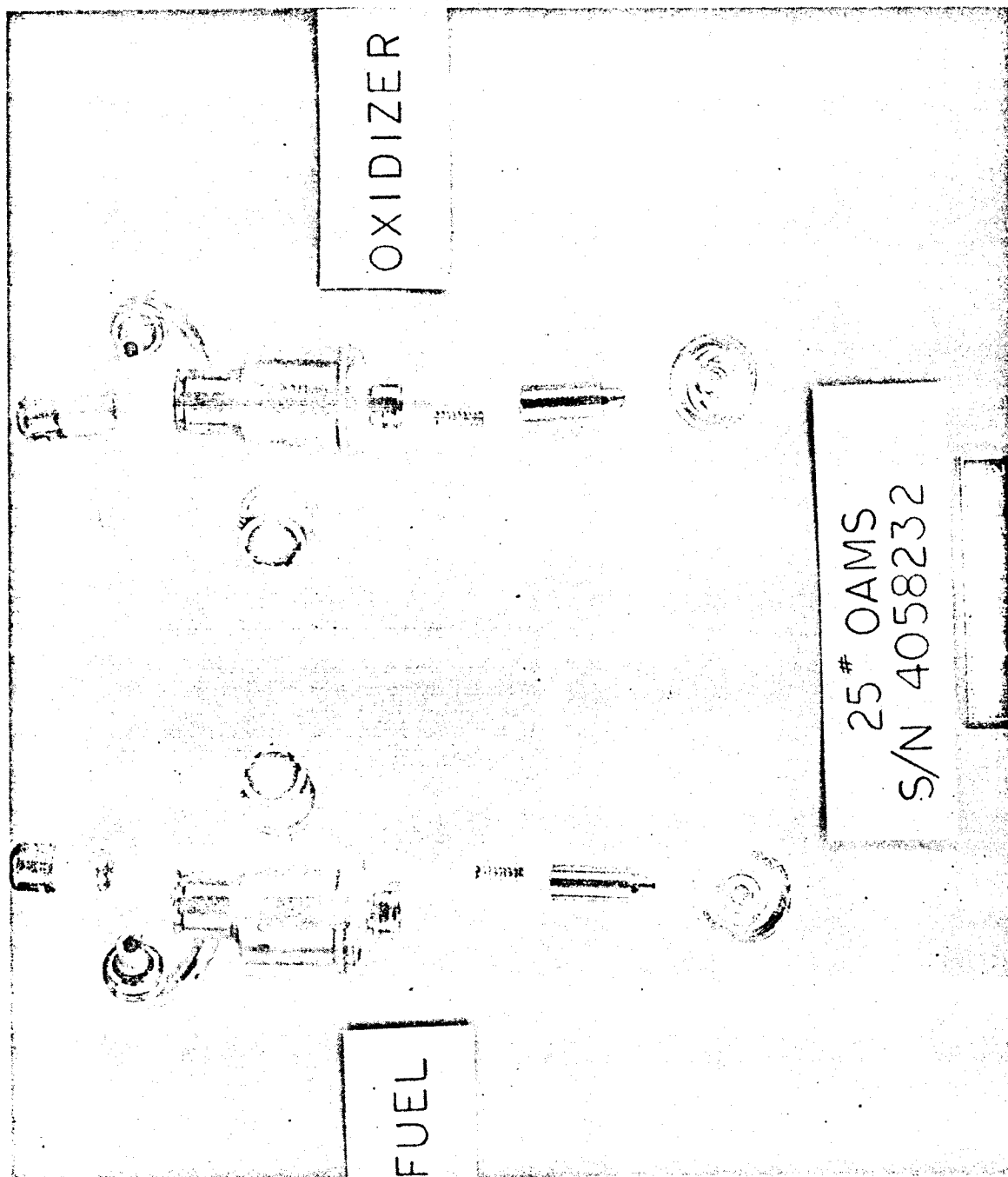


1HE25-10/7/64-S1A*



1HE25-10/7/64-S1C*

Figure 9. 25-Pound-Thrust OAMS TCA DAT Unit 1
Post-MDC to Failure Test, View 2



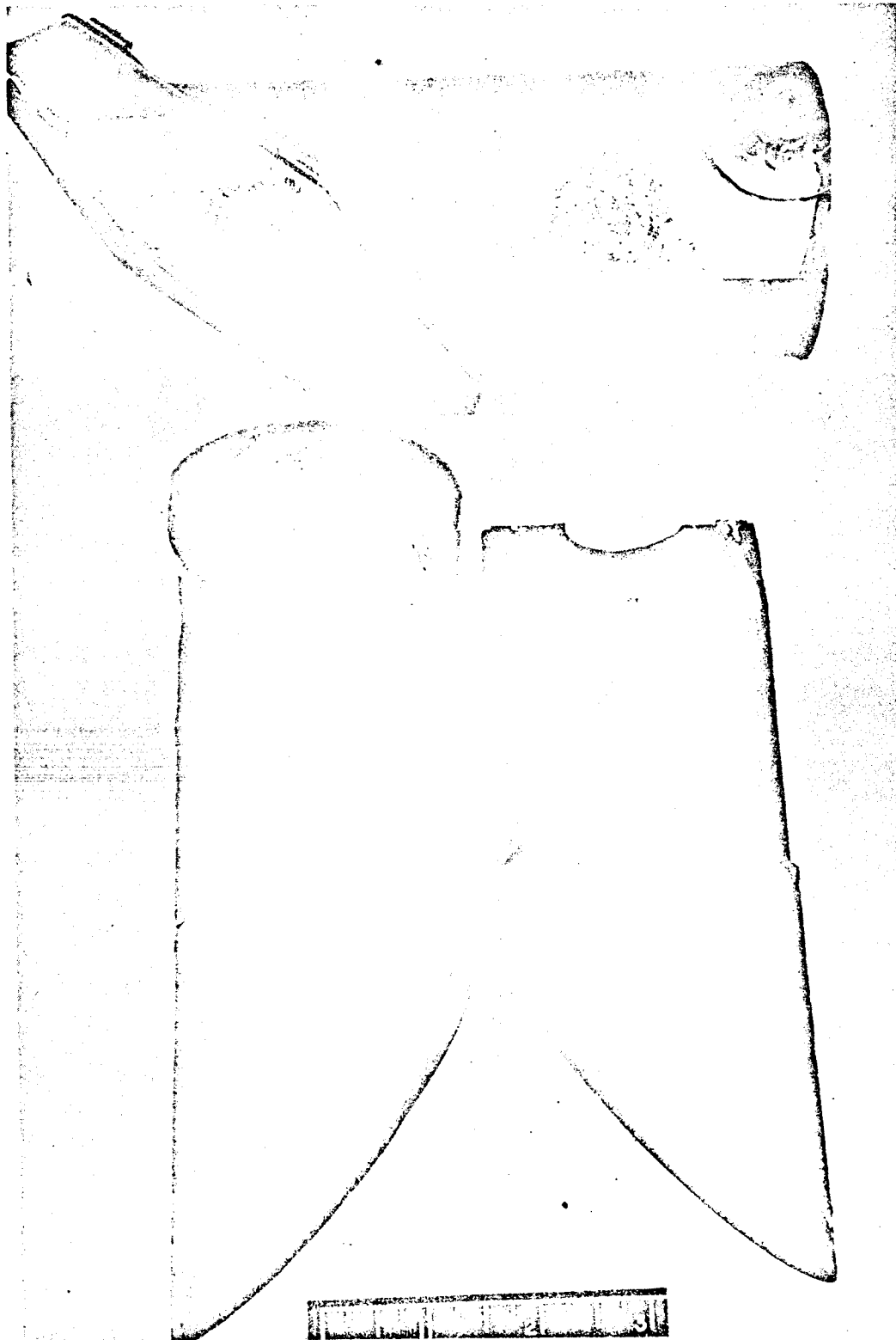
IHE65-7/1/65-C1

Figure 10. 25-Pound-Thrust OAMS TCA DAT Unit 2 Propellant Valves
Disassembly and Inspection



ROCKETDYNE

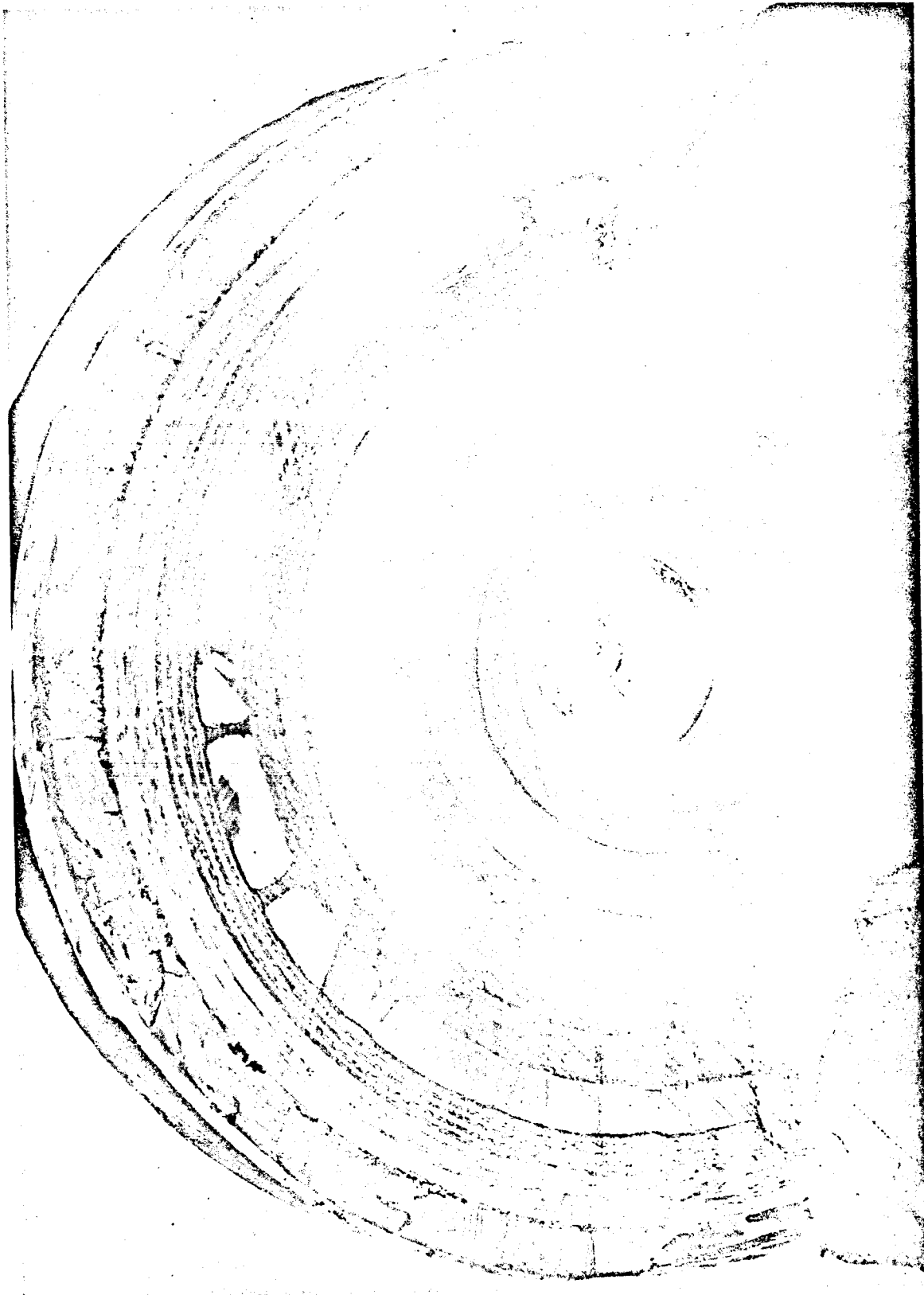
A DIVISION OF NORTH AMERICAN AVIATION, INC.



1HE35-5/13/65-C1B

Figure 11. 25-Pound-Thrust OAMS TCA DAT Unit 2 Disassembly
and Inspection, Post-MDC to Guaranteed Life
Test, View 1

R-15019-2

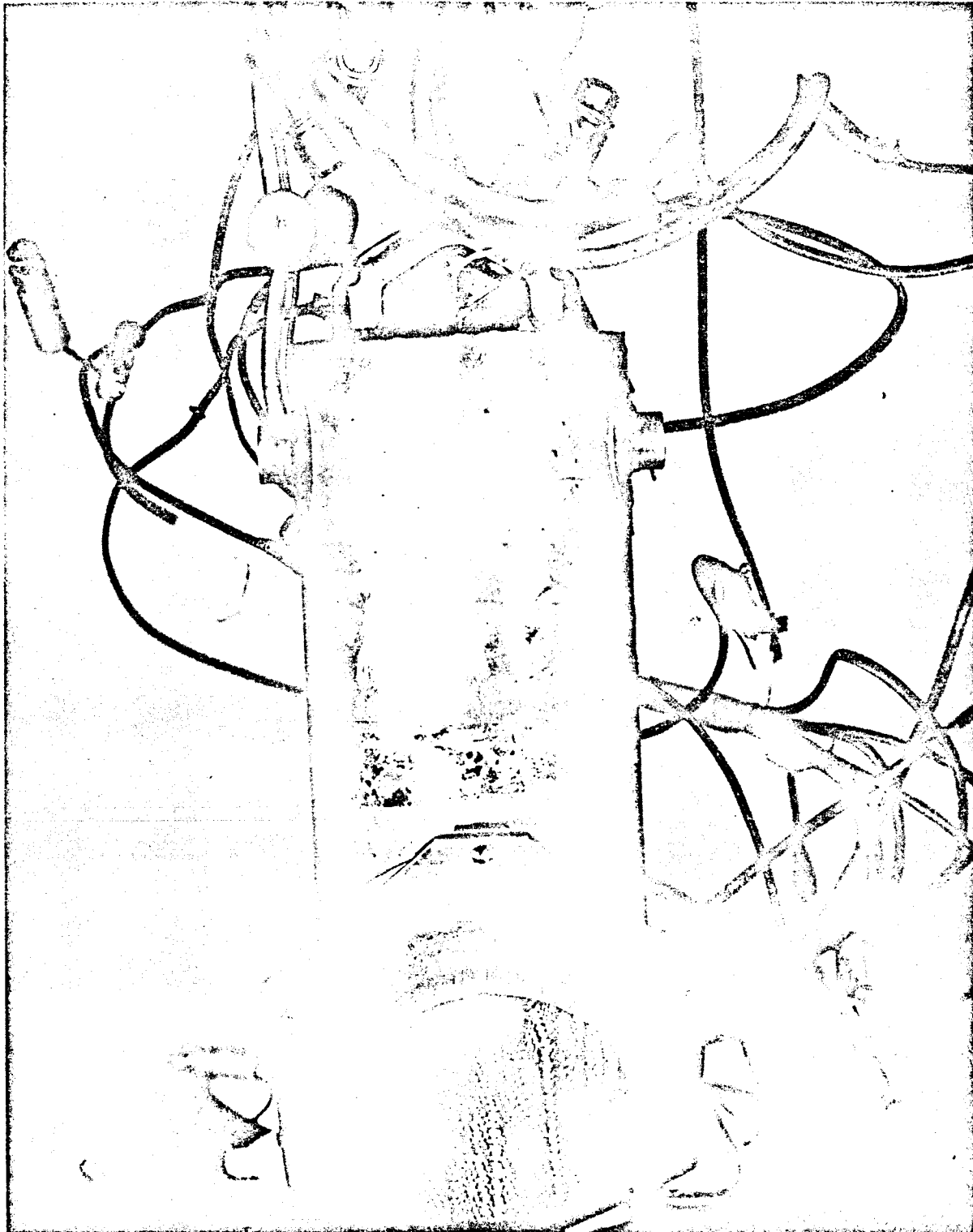


1HE35-5/13/65-CLA

Figure 12. 25-Pound-Thrust OAMS TCA DAT Unit 2 Disassembly and Inspection, Post-MDC to Guaranteed Life Test, View 2

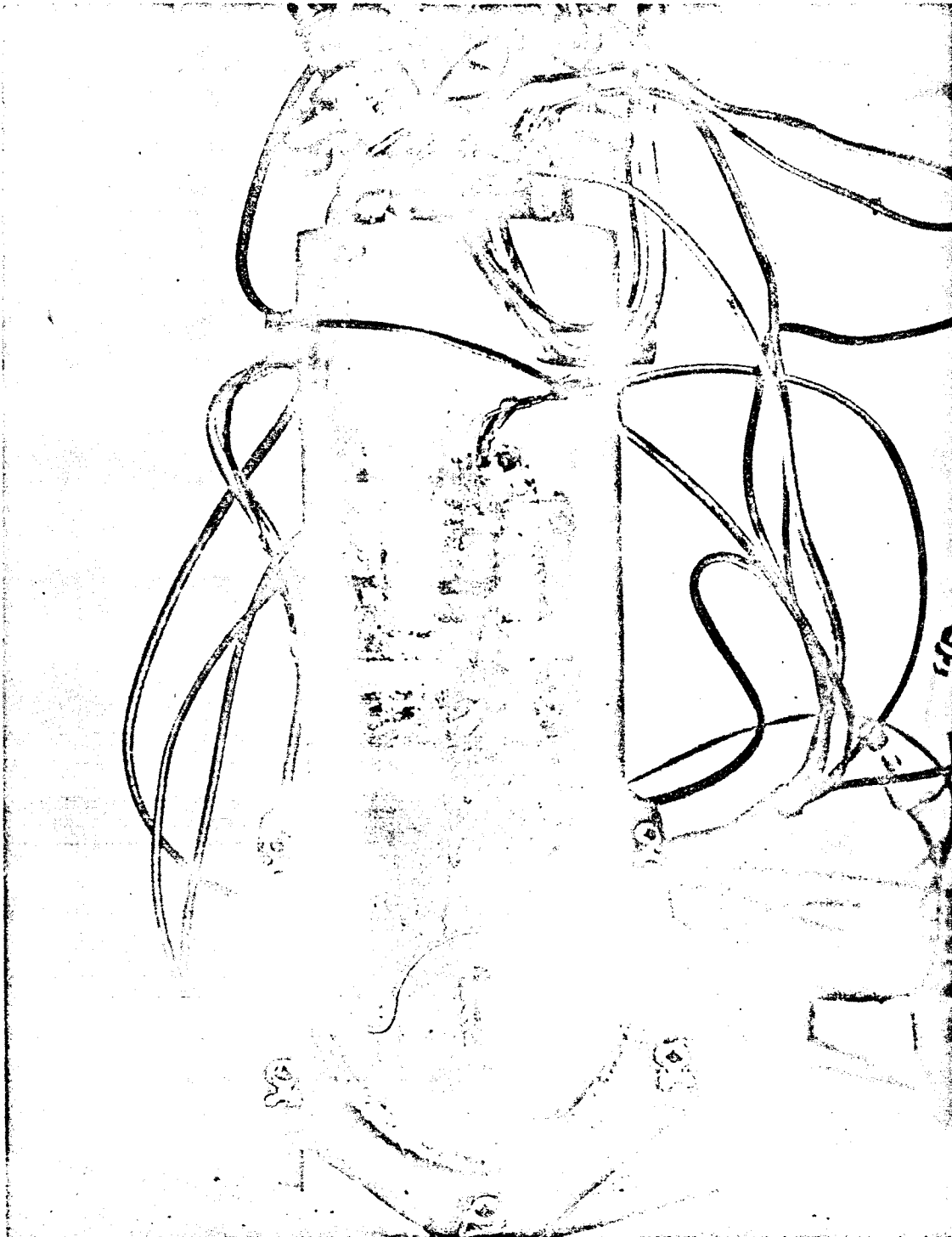


1HD25-1/29/65-S3B*
Figure 13. 25-Pound-Thrust OAMS TCA DAT Unit 2 Post-MDC to Guaranteed Life Test, View 1



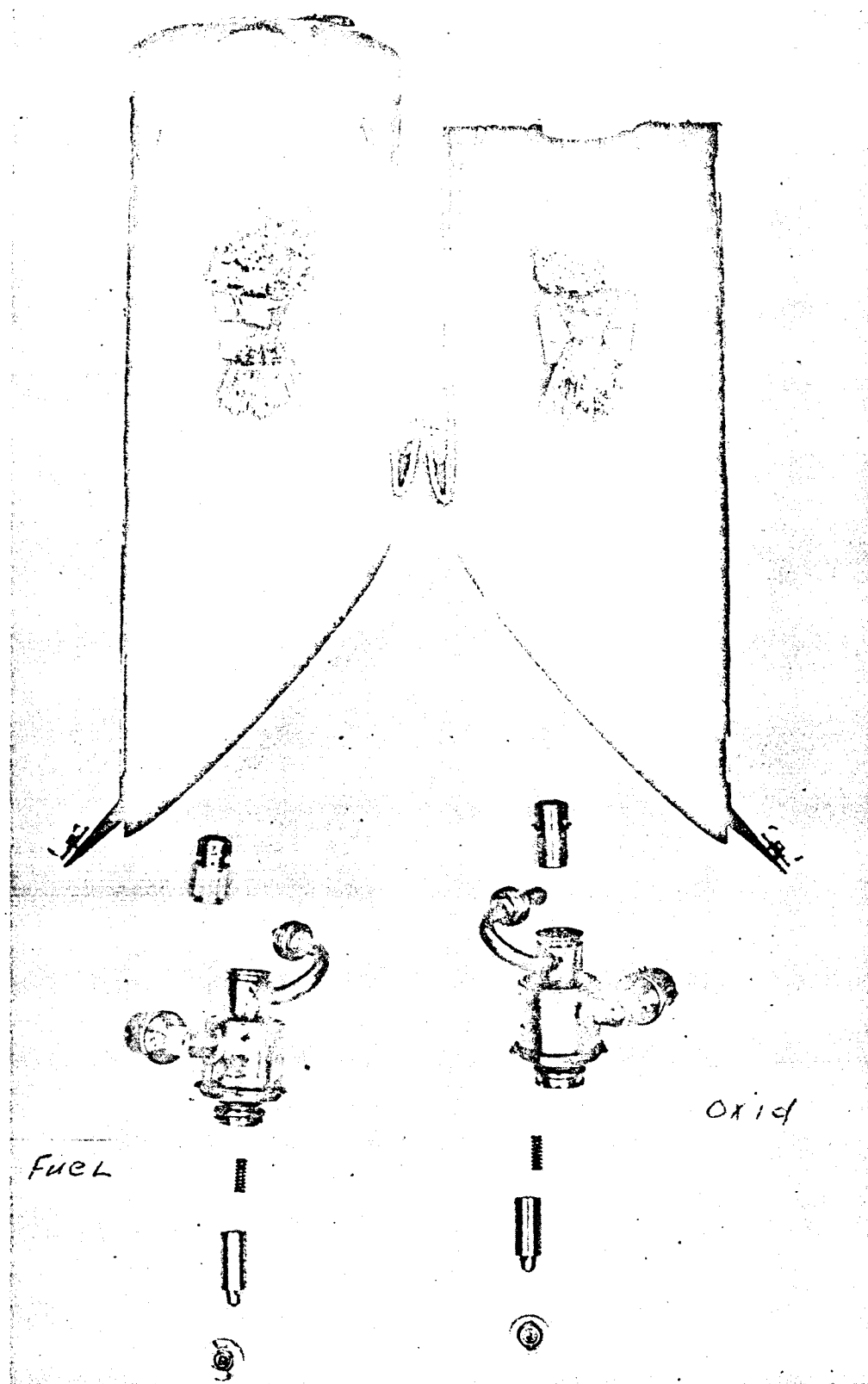
1HD25-1/29/65-S3C*

Figure 14. 25-Pound-Thrust OAMS TCA DAT Unit 2 Post-MDC to
Guaranteed Life Test, View 2



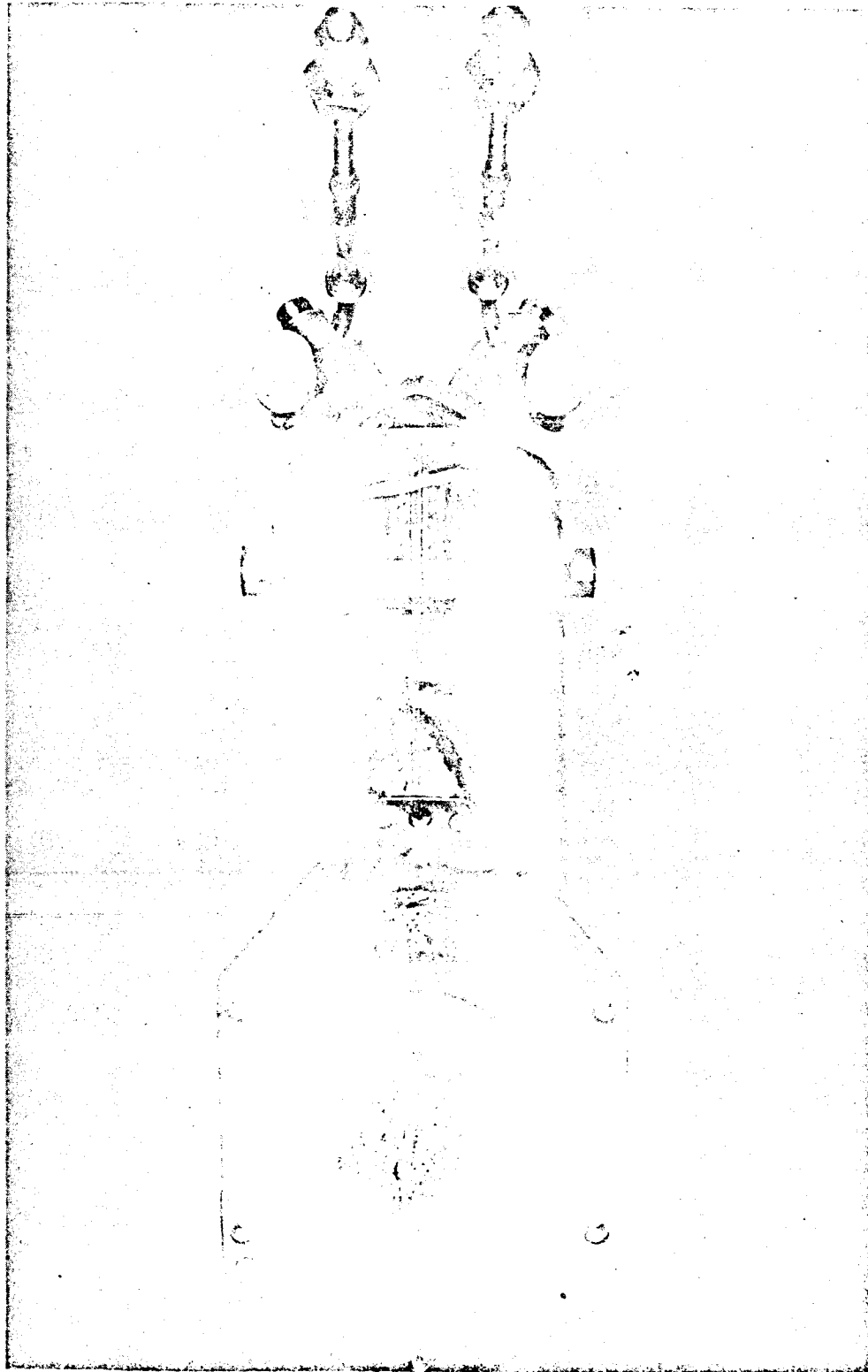
1HD25-1/29/65-S3A*

Figure 15. 25-Pound-Thrust OAMS TCA DAT Unit 2 Post-MDC to
Guaranteed Life Test, View 3



1HE35-8/12/65-C1B

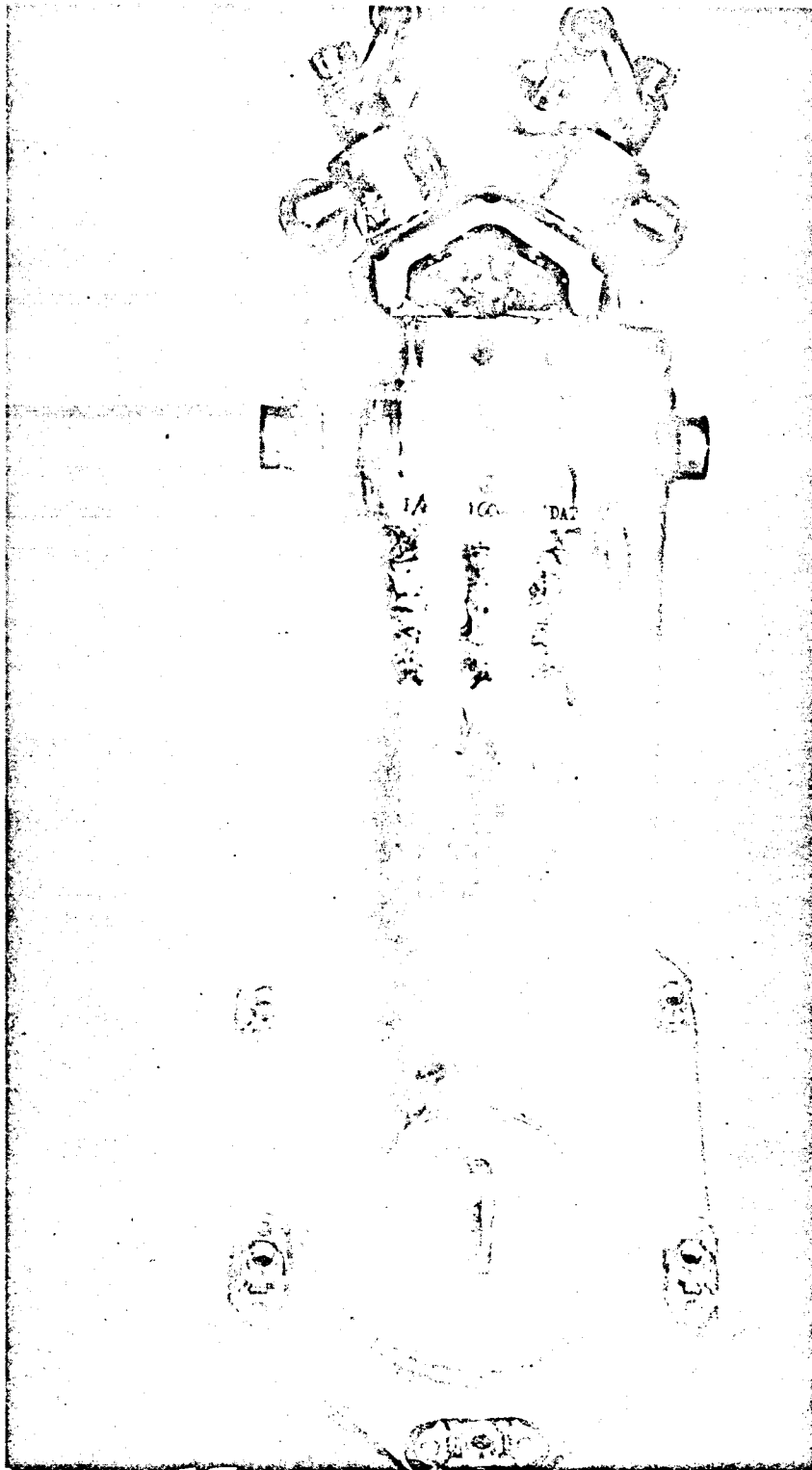
Figure 16, 25-Pound-Thrust OAMS TCA DAT Unit 3 Disassembly and Inspection, Post-MDC to In-Specification Life and Hot-Fire Burst Pressure Test



1HE25-11/4/64-S1B*

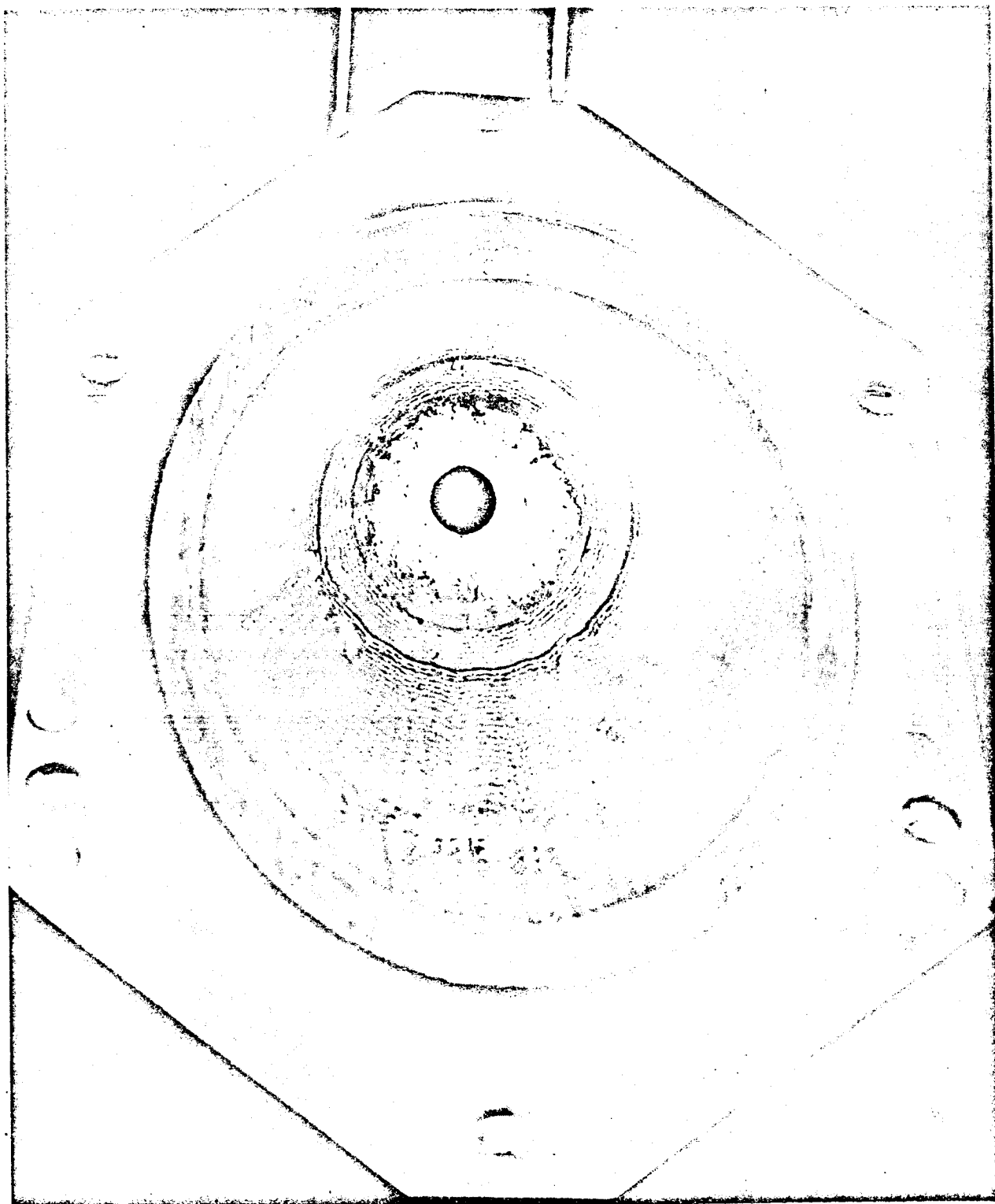
Figure 17. 25-Pound-Thrust OAMS TCA DAT Unit 3
Post-MDC to In-Specification Life and
Hot-Fire Burst Pressure Test, View 1

R-15019-2



1HE25-11/4/64-S1A*

Figure 18. 25-Pound-Thrust OAMS TCA DAT Unit 3 Post-MDC to In-Specification Life and Hot-Fire Burst Pressure Test, View 2



1HE25-11/4/64-S1C*

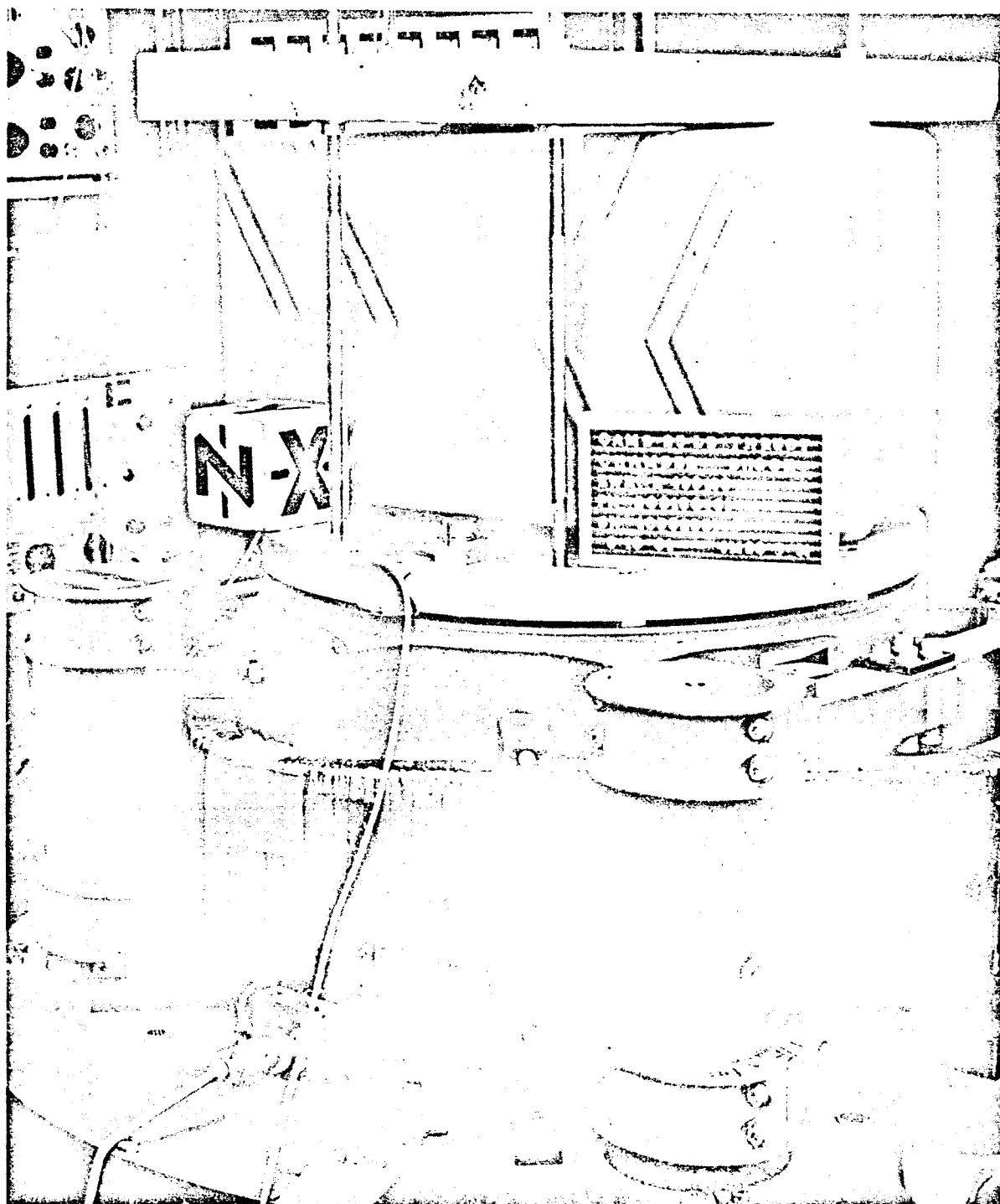
Figure 19. 25-Pound-Thrust OAMS TCA DAT Unit 3 Post-MDC to In-Specification Life and Hot-Fire Burst Pressure Test, View 3

R-15019-2



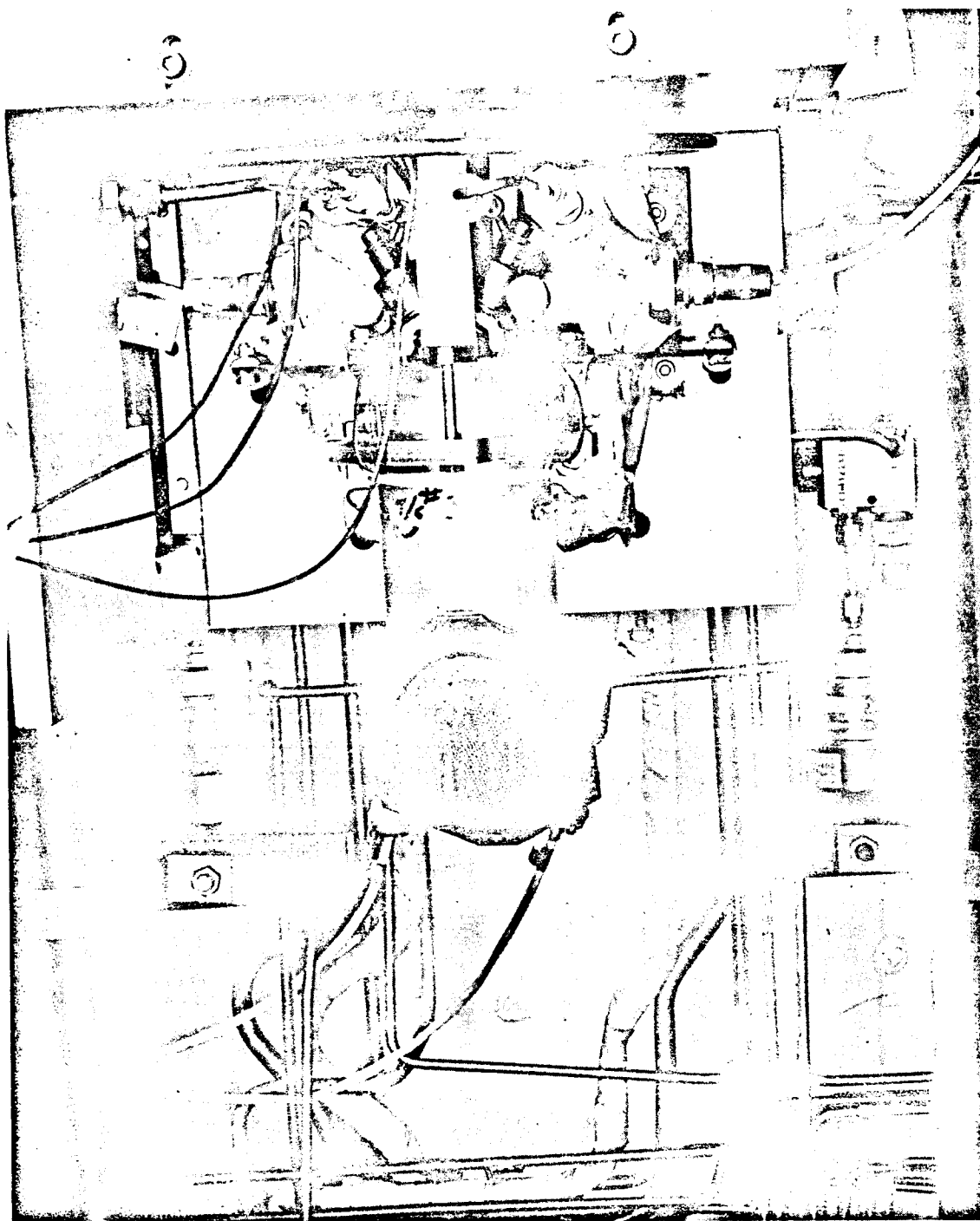
1HE34-9/3/64-C1

Figure 20. 25-Pound-Thrust OAMS TCA DAT Unit 1 X-Axis Vibration Test Installation.



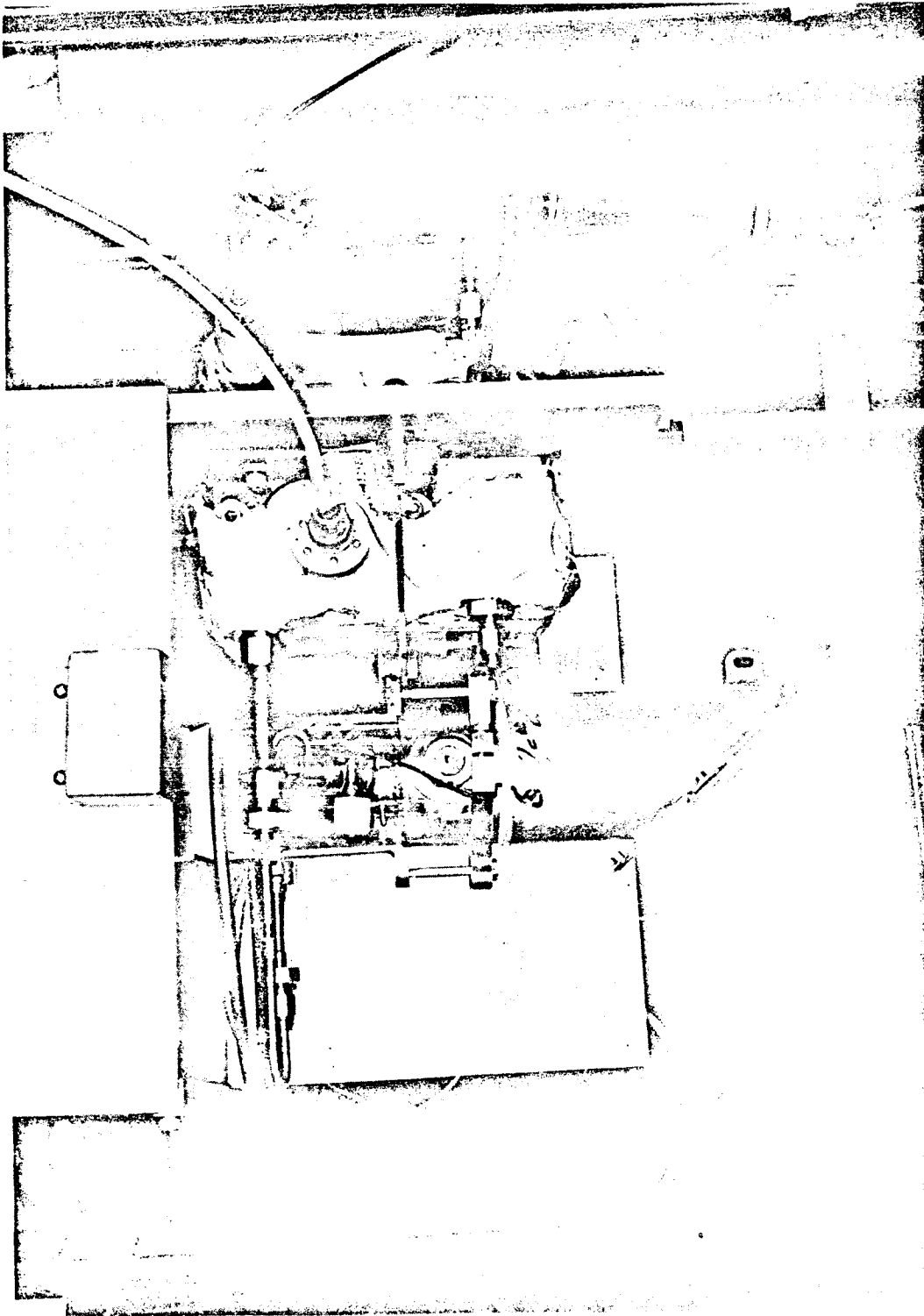
1HE34-9/10/64-C1

Figure 21. 25-Pound-Thrust OAMS TCA DAT Unit 1 Mechanical Shock Test Installation



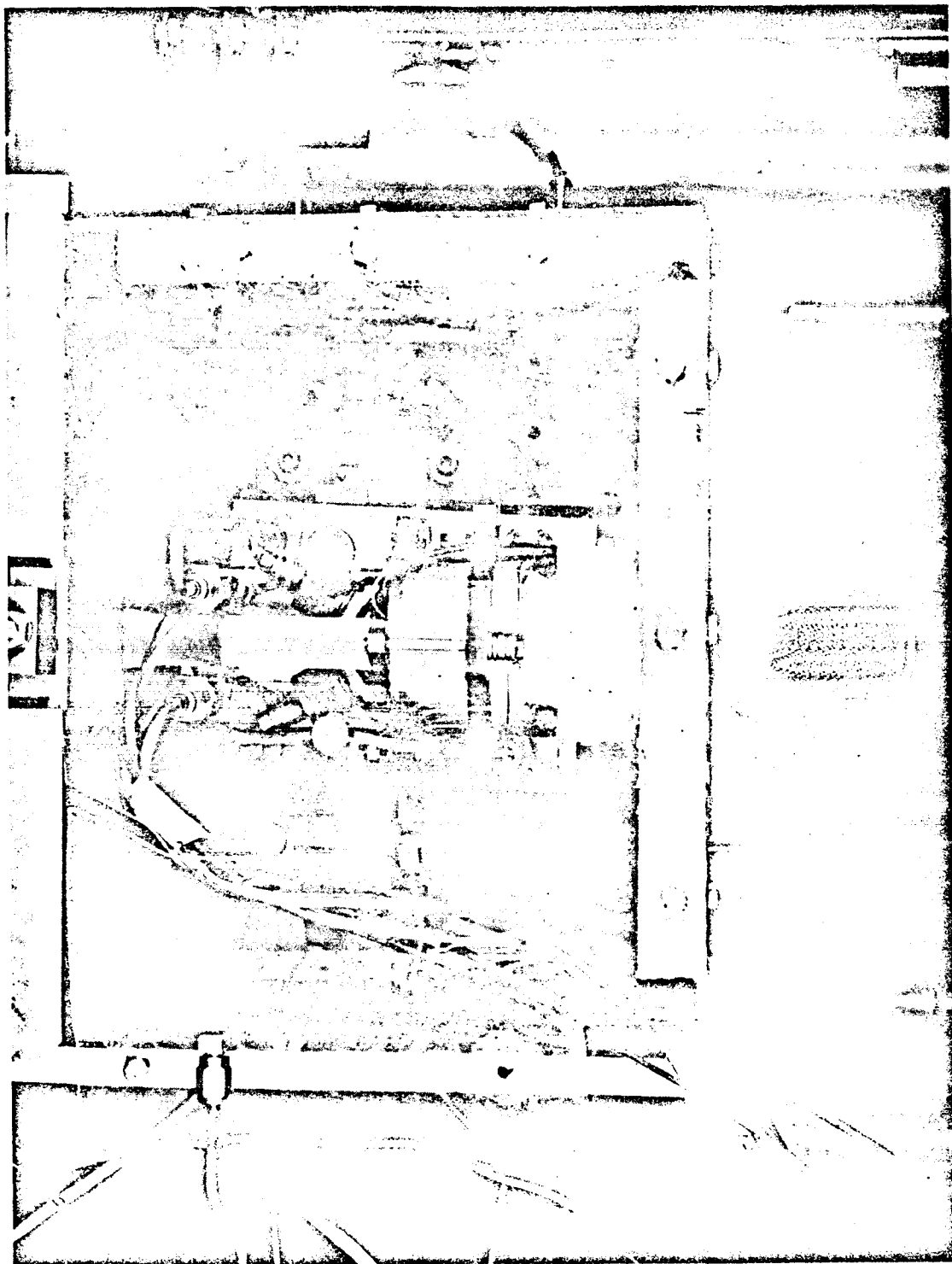
1HD33-10/1/64-S1A

Figure 22. 25-Pound-Thrust OAMS TCA DAT Unit 1 Hot-Fire Test
Installation, CTL-3, Cell 39J, View 1



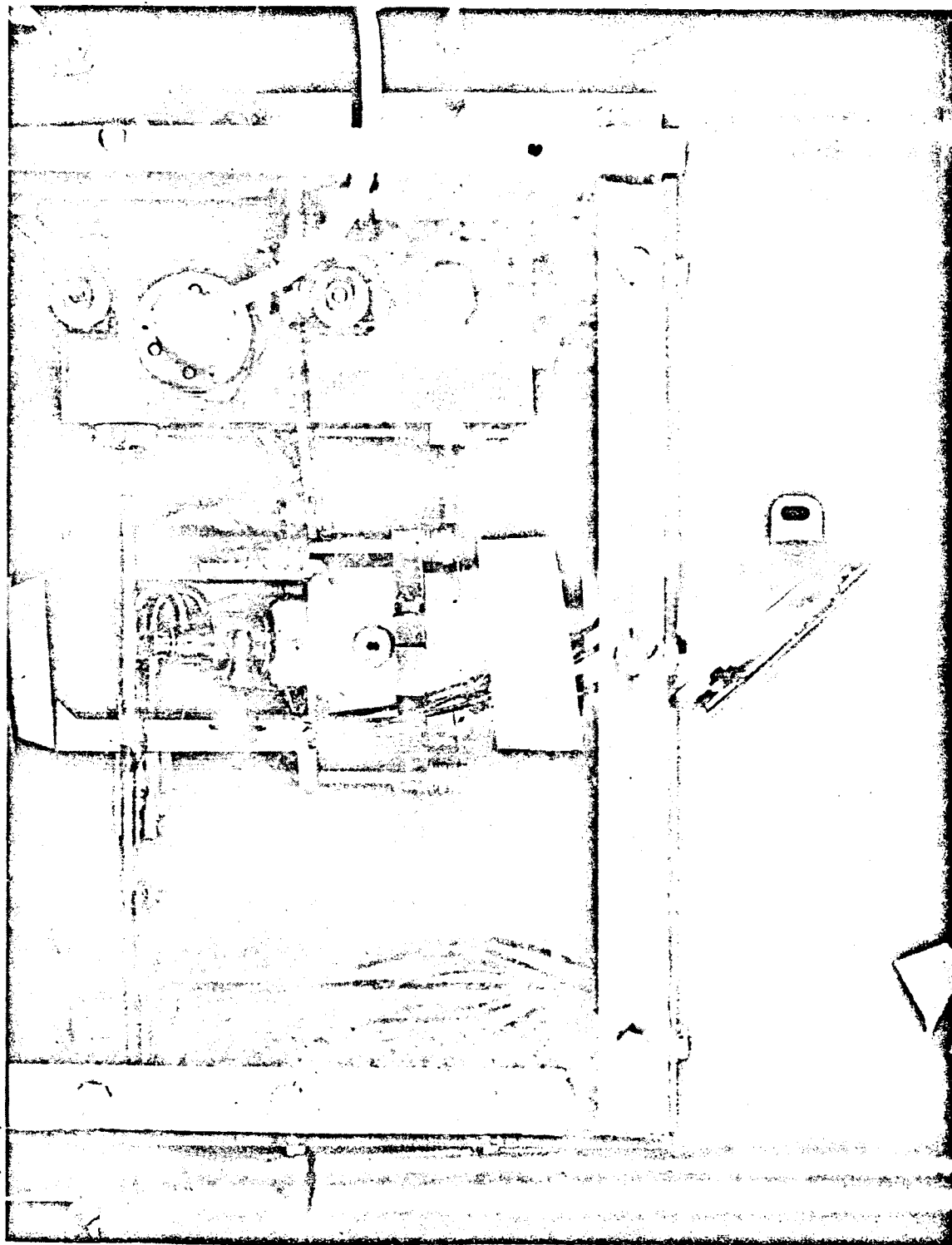
1HD33-10/1/64-SLB

Figure 23. 25-Pound-Thrust OAMS TCA DAT Unit 1 Hot-Fire Test Installation,
CTL-3, Cell 39J, View 2

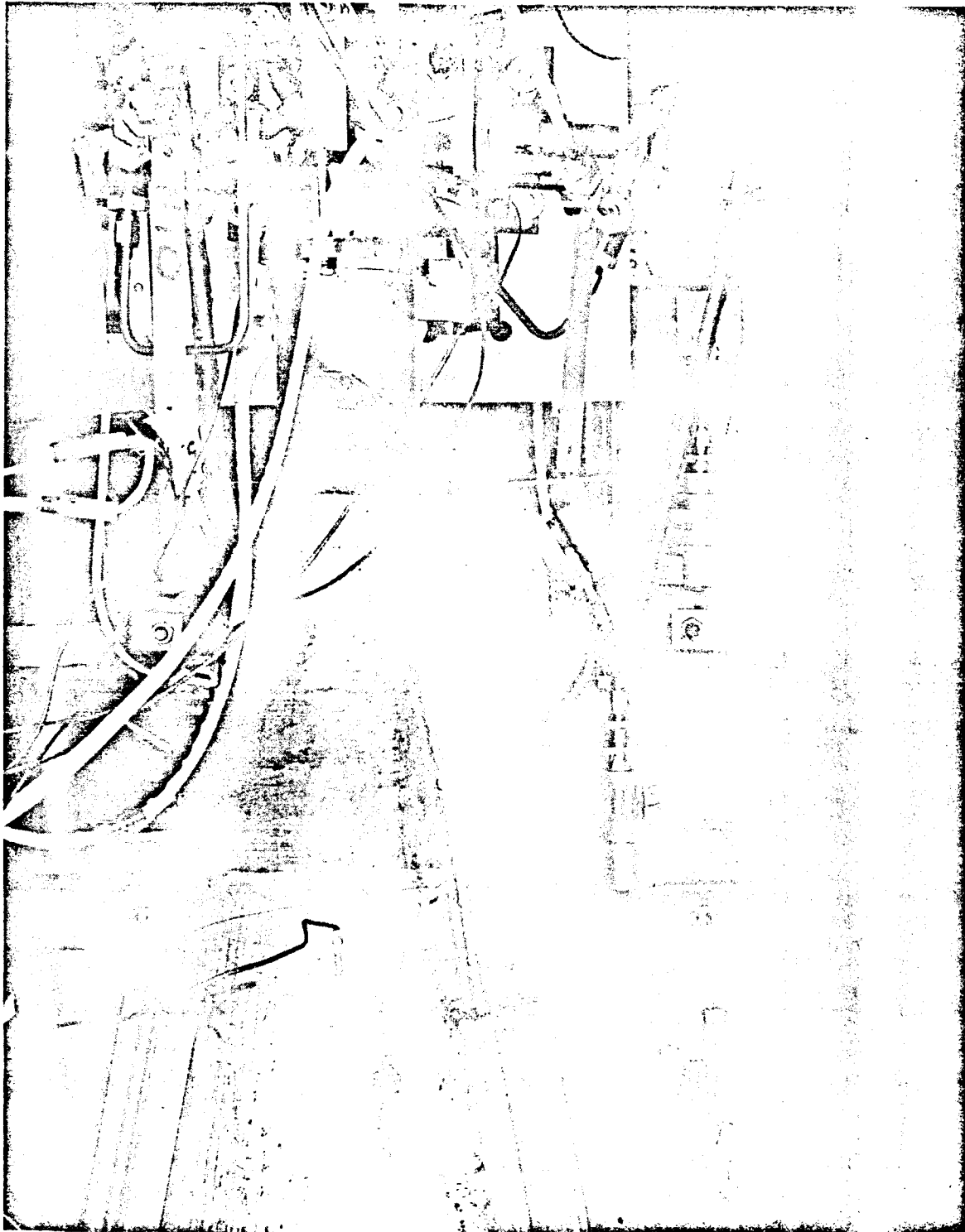


1HD23-1/28/65-S1B*

Figure 24. 25-Pound-Thrust OAMS TCA DAT Unit 2 Impulse-Signal Width Test Installation,
Cell 39J, View 1

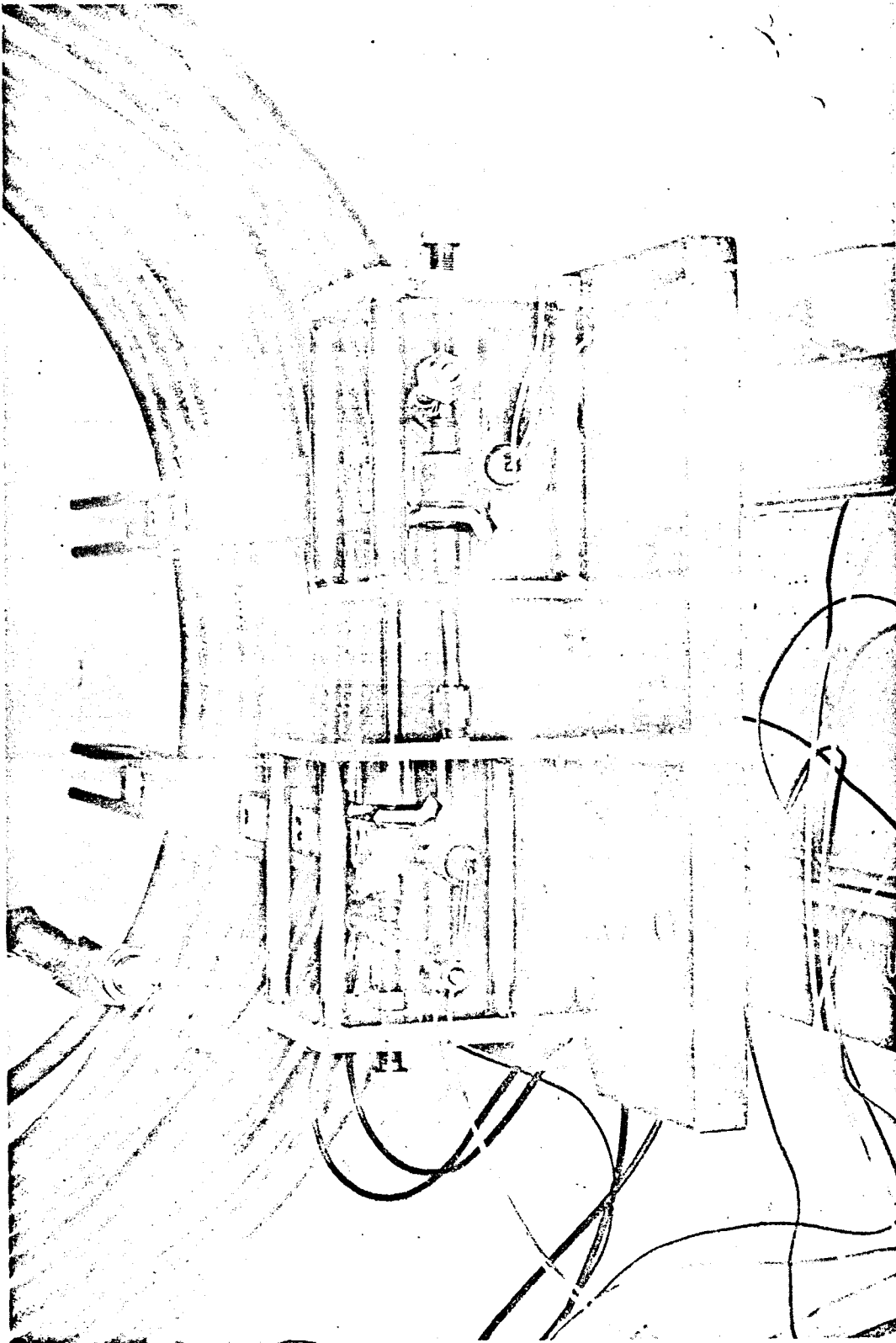


1HD23-1/28/65-SLA*
Figure 25. 25-Pound-Thrust OAMS TCA DAT Unit 2 Impulse-Signal Width Test Installation,
Cell 39J, View 2



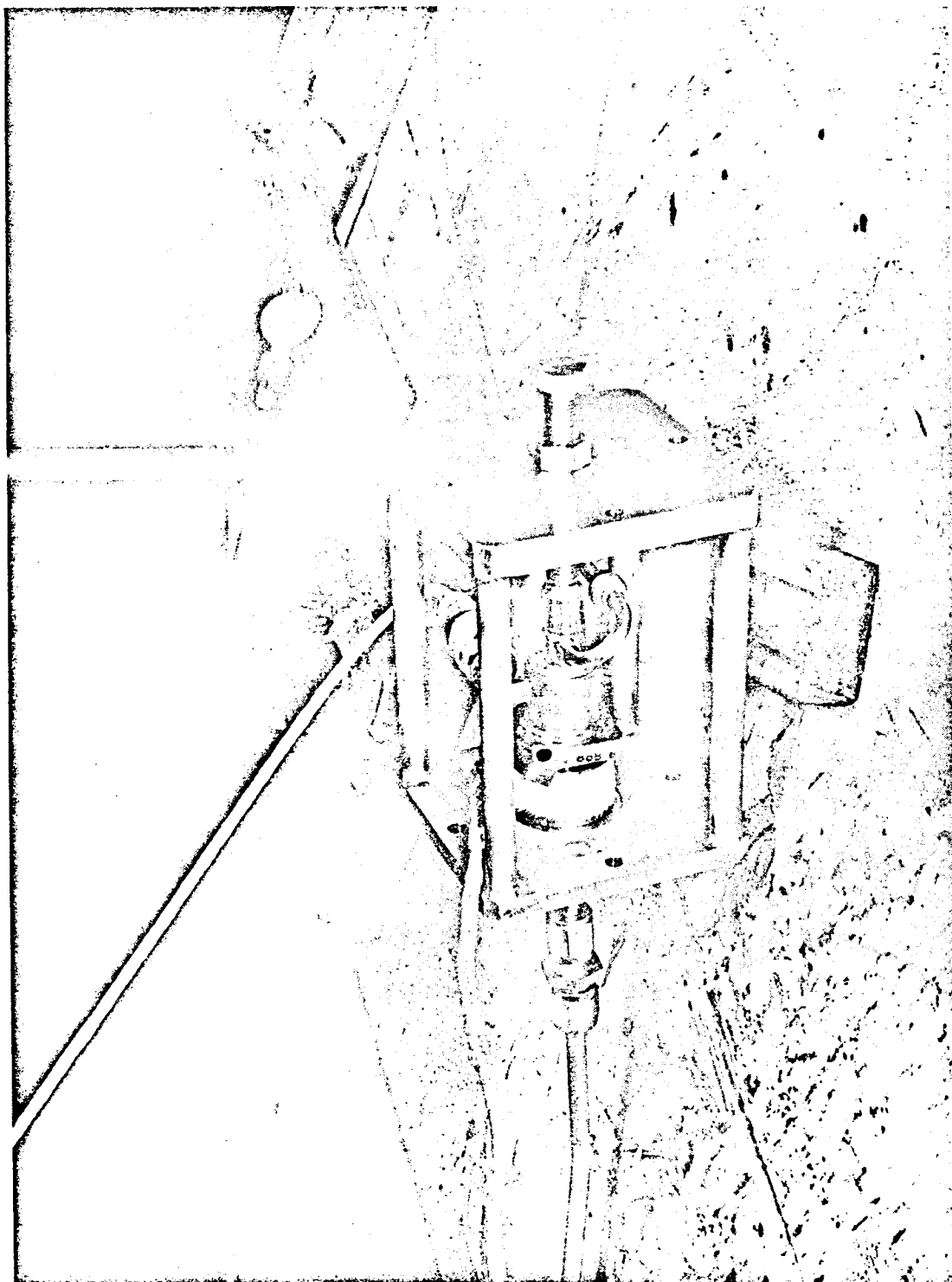
1HD23-11/3/64-S1B

Figure 26.. 25-Pound-Thrust OAMS TCA DAT Unit 3 Hot-Fire Test Installation
Showing Hot-Gas Collection Cone, CTL-3, Cell 39J



6CH46-11/5/64-S1

Figure 27. 25-Pound-Thrust OAMS TCA DAT Unit 1 Propellant Valves
Explosive Atmosphere Test Installation



1HE62-11/12/64-S1C

Figure 28. 25-Pound-Thrust OAMS TCA DAT Unit 1 Fuel Propellant Valve Propellant
Resistance Test Installation

APPENDIX B



APPENDIX B

OPERATION AND FAILURE REPORTS AND
FAILURE ANALYSIS REPORTS



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Operation and Failure Report ROCKETDYNE

☒ FAILURE ☐ OPERATION
☒ PART CHANGE ☐ TIME ☐ TO
☐ FAILED ☐ EXPIRED ☐ DEFECTED

DATE: **SE-7** LOCATION: **NACA** NO: **12895R**

PART IDENTIFICATION			
1 PART NO. 907559		2 PART NAME Oxidizer Propellant Valve	
3 SERIAL NO. 9193579	4 MFG. NAME Rocketdyne	5 MFR. CODE 056-05	6 REF. DESIG.
7 NEXT ASSY PART NO.	8 NEXT ASSY SERIAL	9 NEXT ASSY NAME	
10 MISSILE SERIAL NO.	11 ENG. AGE MODEL NO. SE7	14 SYSTEM CODE	
12 REF. TAG NO.	13 ENG. AGE SERIAL NO.	15 COMPONENT CODE	
		16 HARDWARE CODE	

PART DISPOSITION	PART REPLACEMENT
1 <input type="checkbox"/> REPAIRED IN PLACE 2 <input type="checkbox"/> REPAIRED & RE-INSTALLED 3 <input type="checkbox"/> ADJUSTED 4 <input type="checkbox"/> ELIMINATED 5 <input type="checkbox"/> CONDEMNED 6 <input type="checkbox"/> HOLD FOR REPAIR 7 <input type="checkbox"/> DEPOT REPAIR 8 <input checked="" type="checkbox"/> FAILURE ANALYSIS 9 <input type="checkbox"/> USED AS IS	10 <input type="checkbox"/> IDENTICAL ITEM 11 <input type="checkbox"/> SUBSTITUTE PART 12 <input checked="" type="checkbox"/> NONE 13 <input type="checkbox"/> NONE AVAILABLE 14 REPLACEMENT PART NO. 15 REPLACEMENT SERIAL NO.
16 FAILED PART SENT TO: OFR CRIB VN#1	
17 C-T	18

FAILURE/OPERATION DATA			
19 FAILURE DATE 64-11-14	20 TEST OPER. DATE 64-11-14	21 TEST OPER. NO.	22 ITEMS 1
23 PROCEDURE—SPEC. & PARAGRAPH 208160-401 / 7.1.7			
24 FS	25 FAIL TYPE	26 FAIL. CODE	27 SECONDS
28 SV	29 MONTHS	30 INITIAL REPORT NO.	31
32 NC	33		
12 OPERATION REPORTED OR IN PROGRESS		34 TIME PERIOD (ACCEPT/R&D/STATIC TEST ONLY)	
A <input type="checkbox"/> COMP/ASSY TEST B <input type="checkbox"/> FINAL ENG. ASSY. C <input type="checkbox"/> ELEC-MECH. CHECK D <input type="checkbox"/> ACCEPT/R&D TEST E <input type="checkbox"/> STORAGE F <input type="checkbox"/> SHIPPING G <input type="checkbox"/> RECEIVING INSP.		H <input type="checkbox"/> MAINTENANCE I <input type="checkbox"/> LEAK & FUNCTION J <input type="checkbox"/> SIM. LAUNCH K <input type="checkbox"/> MISSILE ACCEPT. L <input type="checkbox"/> STAT. MISS. TEST M <input type="checkbox"/> PROPEL. LOADING N <input type="checkbox"/> PERIODIC INSP.	
		1 <input type="checkbox"/> PRE-TEST 2 <input checked="" type="checkbox"/> TEST 3 <input type="checkbox"/> POST-TEST	

REPORTED BY		
42 NAME R. Cole	43 GROUP 388	44 SUPPLEMENT SHEET 1 <input type="checkbox"/> YES 2 <input type="checkbox"/> NO
45 APPROVED [Signature]	46 ACTIVITY	47 STAND/AREA
ANALYSIS ASSIGNED TO		
48 NAME W. Smith	49 GROUP/SCODE 335 AR	50 PART REQ. X YES <input type="checkbox"/> NO
51 DATE REPORT RECEIVED VS MO DAY	52 DATE REPORT DISTRIBUTED VS MO DAY	53
54 TEST OPER. NO.	55 1 56 2	57 NTH CODE 58 TAPE CODE

DESCRIPTION OF FAILURE	WHEN WHERE HOW MUCH	CAUSE EFFECT COMMENTS	PAR DUE RELIABILITY
35 VALVE INOPERATIVE DURING OXIDIZER 36 RESISTANCE TEST AFTER ONE AND A HALF 37 DAYS OF TESTING. SUSPECT RUBBER 38 CONTAMINATION IN THE VALVE, FROM 39 THE FACILITY TEST SETUP.	70	71 TEST OPER. NO. 12895 RA	72 73 74 75 76 77 78 79 80
	70		78 B
	70		78 C
	70		78 D
	70		78 E
	70		78 F
36 REF OFR	42 REF OFR	48 REF OFR	54 FAILED DETAIL PART NO.

RELIABILITY ANALYSIS USE ONLY											
IDENTIFICATION		16 TEST TYPE		10 GROUP		15 PA CODE		17 LEAK		30 PROP SYSTEM	
18 NTH CUMP		40 ASSY		RS 2		CO 46		65 DELETE		70	
REPLACEMENT PART NO.				15 REPLACEMENT N				22 NAME		25 TYPE	
30 INSTALLATION PART NO. R-15019-2				30 CODE				37 NAME		60 GR ALSP	
								31 MFR		35	
										61 78 80	

D. B. Back 11/84 394

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO. 12895R	OFR BY R. Cole NAME	806-388 DEPT. & GROUP	LOCATION NACA	FAILURE DATE 11-14-64
-------------------	---------------------------	--------------------------	------------------	--------------------------

ART IDENTIFICATION

PART NO. 407559	SERIAL NO. 9193579	PART NAME Oxid. Valve	MFR. NAME Rocketdyne
ENG/AGE MODEL NO. SE-7	ENG/AGE SERIAL NO.	TEST/OPERATION NO.	

ANALYSIS BY

NAME R. Clark <i>my elch</i>	DEPT. & GROUP 806-335	ANALYSIS DATE 11-21-64	APPROVAL <i>W. Smith 11/21/64</i> <i>R. Clark</i>	DSN DATE
---------------------------------	--------------------------	---------------------------	---	----------

FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION

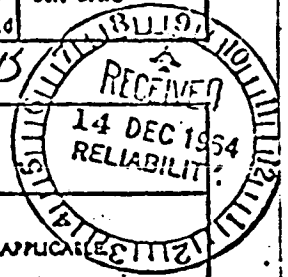
STATE ITEM NUMBER AND DESCRIBE USE EXTRA SHEETS IF NECESSARY

BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

1. It was reported by the OFR that the subject valve failed to operate during a DAT oxidizer resistance test. The OFR stated: "Valve inoperative during oxidizer resistance test after one and a half days of testing. Suspect rubber contamination in valve from the facility test set-up."
2. The valve was sent to D/596-149 Laboratory for failure analysis which consisted of the following functional tests with no inlet pressure:
 - a. The pull-in current was checked and was found to be .15 AMPS.
 - b. The drop-out current was checked and was found to be .046 AMPS.
 - c. The energize time was checked and was found to be .0055 SEC with an applied current of .37 AMPS.
 - d. The de-energize time was checked and found to be .0014 SEC with the valve de-energized from .72 AMPS.

The above functional tests indicated that the valve was operating within specification. A trip was then made to the test site to examine the test set-up to determine if the failure could have been due to a test facility problem. The following information was obtained:

- a. The electrical cable which connected the valve to the power supply was found to be damaged. The insulation was burned off in several places which caused a direct short when power was applied.
- b. A fire had occurred in the chamber which burned the cable.
- c. The fire was caused by leaking NTO.
- d. The NTO leakage was caused by the use of a rubber "O" Ring in the test set-up filter connection, which was accidentally installed. A teflon "O" Ring should have been used.



OFR NO.
12895R

The valve was sent to the M & P lab for flushing. The effluent was analyzed to determine if corrosion processes had started inside the valve. The analysis indicated that corrosion had not started. The valve was returned to the DAT unit. It was recommended that the valve be given a complete functional test. If the valve passes the functional test, it will be re-started in the oxidizer resistance test.

3. It is concluded that the reported failure was actually a test facility malfunction. The test valve did not actuate because of the faulty electrical cable.
4. No corrective action on the valve is required as the valve did not actually fail. The use of an improper "O" Ring which resulted in leakage and fire has been discontinued. All "O" Rings were checked to insure no further problems of this type.

Item 31 52-52701

FAILURE ANALYSIS	
ACCEPTED	
W. G. Jackson	12/22/64
W. H. F. Zuck	1/12/65
RELIABILITY DEPT. 261 MCDONNELL AIRCRAFT CORP.	

Operation and Failure Report ROCKETDYNE

☒ FAILURE

☐ OPERATION

PROGRAM

LOCATION

No 12917R

☐ FAILED ITEM

PART CHANGE

☐ TIME EXPENDED

☐ TO DIRECTOR

SE-7

CTL

III

PART IDENTIFICATION

1 PART NO 208160-61		2 PART NAME 25 LB TCA-OAMS	
3 SERIAL NO. 4058233	4 MFG. NAME ROCKETDYNE	5 MFR. CODE 02602	6 REF. DESIG.
7 NEXT ASSY PART NO. NONE	8 NEXT ASSY SERIAL NONE	9 NEXT ASSY NAME NONE	
10 MISSILE SERIAL NO.	11 ENG AGE MODEL NO. SE-7	14 SYSTEM CODE	
12 REJ. TAG NO.	13 ENG AGE SERIAL NO.	15 COMPONENT CODE	
		16 HARDWARE CODE	

PART DISPOSITION

PART REPLACEMENT

1 <input type="checkbox"/> REPAIRED IN PLACE	36
2 <input type="checkbox"/> REPAIRED & RE-INSTALLED	1 <input type="checkbox"/> IDENTICAL ITEM
3 <input type="checkbox"/> ADJUSTED	2 <input type="checkbox"/> SUBSTITUTE PART
4 <input type="checkbox"/> ELIMINATED	3 <input type="checkbox"/> NONE
5 <input type="checkbox"/> CONDEMNED	4 <input checked="" type="checkbox"/> NONE AVAILABLE
6 <input type="checkbox"/> HOLD FOR REPAIR	37 REPLACEMENT PART NO.
7 <input type="checkbox"/> DEPOT REPAIR	38 REPLACEMENT SERIAL NO.
8 <input checked="" type="checkbox"/> FAILURE ANALYSIS	
9 <input type="checkbox"/> USED AS IS	

FAILURE/OPERATION DATA

17 FAILURE DATE 4 10 15	18 TEST OPER DATE 4 10 3	19 TEST OPER NO. 957/090	20 ITEMS 1
PROCEDURE - SPEC. & PARAGRAPH 208160-401 / 7.1.4			

22 FS	25 FAIL. TYPE	26 FAIL. CODE	27 SECONDS 118	28 STARTS 1746
23 SV	29 MONTHS 6	30 INITIAL REPORT NO. NONE	31	
24 NC				

32 OPERATION REPORTED OR IN PROGRESS

A <input type="checkbox"/> COMP ASSY TEST	H <input type="checkbox"/> MAINTENANCE
B <input type="checkbox"/> FINAL ENG. ASSY.	I <input type="checkbox"/> LEAK & FUNCTION
C <input type="checkbox"/> ELEC. MECH. CHECK	J <input type="checkbox"/> SIM. LAUNCH
D <input type="checkbox"/> ACCEPT/RAD TEST	K <input type="checkbox"/> MISSILE ACCEPT.
E <input type="checkbox"/> STORAGE	L <input checked="" type="checkbox"/> STAT. MISS. TEST
F <input type="checkbox"/> SHIPPING	M <input type="checkbox"/> PROPEL. LOADING
G <input type="checkbox"/> RECEIVING INSP.	N <input type="checkbox"/> PERIODIC INSP.

34 TIME PERIOD (ACCEPT R&D/ STATIC TEST ONLY)

1 <input type="checkbox"/> PRE-TEST
2 <input checked="" type="checkbox"/> TEST
3 <input type="checkbox"/> POST-TEST

REPORTED BY

42 NAME John D. Genger	43 GROUP 322	44 SUPPLEMENT SHEET 1 YES 2 NO
45 APPROVED BY [Signature]	46 ACTIVITY 89	47 STAND AREA 9.57

ANALYSIS ASSIGNED TO

48 NAME H. MARSDEN	49 GROUP CODE 3351 AR	50 PART REQ. YES <input checked="" type="checkbox"/> NO
-----------------------	--------------------------	--

DATE REPORT RECEIVED 4 10 15	52	DATE REPORT DISTRIBUTED 4 10 15	53
---------------------------------	----	------------------------------------	----

54 TEST OPER NO 10 USE ONLY	55 1	56 2	57 NTH CODE	58 TAPE CODE
--------------------------------	------	------	-------------	--------------

DESCRIPTION OF FAILURE

WHEN?
WHERE?
HOW MUCH?

CAUSE?
EFFECT?
COMMENTS?

025 LB. OAMS GEMINE TCA, DAT UNIT
φ. 1, FAILED TO MEET THE THROAT STA
SHELL TEMP. REQUIREMENT AT 118 SE
C. B.T. DURING THE OCA-113 MDC. THE
TEST WAS CONTINUED UNTIL TEMPS. RE
ACHED 200F. NO INCIPIENT MECH. FAIL
URE WAS OBSERVED. THE TEMPS. WERE 5
0 - 100 DEG. F HIGHER THROUGHOUT TH
E MDC THAN PREVIOUS MDC'S. THE PART
HISTORY WAS OBTAINED WITH OCA-115
MDC IN A LARGER ALT. CHAMBER. A.R.

FAR DUE RELIABILITY
01806-394 10-25

71 TEST OPER NO 77 78 79 80
9570090 A

76 B

76 C

76 D

76 E

76 F

76 G

RELIABILITY ANALYSIS USE ONLY

1 IDENTIFICATION	TEST TYPE	10 GROUP RESP. CODE	16 PA CODE	17 AP	18 CF	19 FC	24 LEAK	CONTAM.	30 PROP SYSTEM	32
16 NTH COMP	40 ASSY	RS-2	CD	48					63 DELETE	70
REPLACEMENT PART NO.			15 REPLACEMENTS/N		22 NAME		25 TYPE		31 MFR	
16 INSTALLATION PART NO.			30 CONFIG CODE		37 NAME		60 GR RESP.		CH CL M R	

R-15019-2

OFFR No 12917R

OFR IDENTIFICATION

• ANALYST FILL OUT COVER SHEET ONLY

OFR NO. 12917R	OFR BY J. R. Ganger NAME	896-333 DEPT. & GROUP	LOCATION CTL-III	FAILURE DATE 10-15-64
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PART IDENTIFICATION

PART NO. 209160-61	SERIAL NO. 1.058233	PART NAME Thrust Chamber Assy	MFR. NAME Rocketdyne
ENG/AGE MODEL NO. SE-7	ENG/AGE SERIAL NO. None	TEST/OPERATION NO. 957-090	

ANALYSIS BY

NAME J. W. Sheingold	DEPT. & GROUP 896-335	ANALYSIS DATE 10-20-64	APPROVAL [Signature]	IDENT. DATE 10/28/64
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FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE:

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

1. Gemini 25 lb OAMS DAT Unit No. 1 failed to meet the SCD temperature requirements at 118 seconds of accumulated firing time during the CCA-113 mission duty cycle. The temperature recorded was 50°F greater than the allowable maximum of 550°F. The test was continued to 175 seconds of accumulated CCA-113 mission duty cycle firing time (15 sec. beyond SCD guaranteed life requirements) with no structural failure. The test was conducted in the Tri-Mod test facility.

2. Analysis of the temperature-time data showed the outer shell skin temperatures to be greater throughout the mission duty cycle than anticipated from previous R&D tests. The R&D data was obtained from tests conducted in the large altitude simulator.

Post-test x-ray analysis showed the condition of the TCA to be like R&D chambers similarly tested. Sectioning of the TCA showed it to be charred through. It was thought that the recirculation of exhaust gases in the smaller altitude can (Tri-Mod) could account for the difference in temperature. To determine the extent of artificial skin heating during mission duty cycle testing as a result of hot gas recirculation in the Tri-Mod facility, a controlled test series was conducted using a 25 lb OAMS slave chamber. The test series consisted of both limited steady state and pulse testing at a simulated altitude of 170,000 feet and local ambient temperature. Four (4) strips of 0.375 inch square, 0.10 inch thick plastic packing material were suspended from each corner of the thrust measuring system housing with 4.5 inches of fiberglass string. Motion pictures taken during testing showed the four strips to fluctuate considerably during pulse testing and to stand out at an angle of 45 degrees during steady state firing. A velocity calculation was made on the basis of the steady state results and the velocity required to displace the plastic strips 45 degrees at 170,000 feet was seen to be on the order of 700 mph.

3. Conclusions - The inability of the TCA to meet the SCD temperature requirements is attributed to artificial skin heating resulting from hot exhaust gas recirculation. The motion pictures clearly pointed out the existence of a considerable environmental gas velocity which would not exist in the spacecraft. The hot gas recirculation is seen to be a result of incomplete pick up of the TCA exhaust gases from the Tri-Mod test using. The TCA would have satisfactorily completed the mission duty cycle within the temperature requirements had the hot gas recirculation not occurred.

R-15019-2

65

4. In order to eliminate artificial TCA skin heating in the Tri-Mod facility, a cylindrical shield has been fabricated for all TCA configurations with next part tested effectivity. The shield, fabricated of .020 stainless steel sheet, will be attached to the TCA flange through a formica base plate such that the test environment will more closely simulate that which the TCA would see during Gemini spacecraft operation. (See Figure 1)

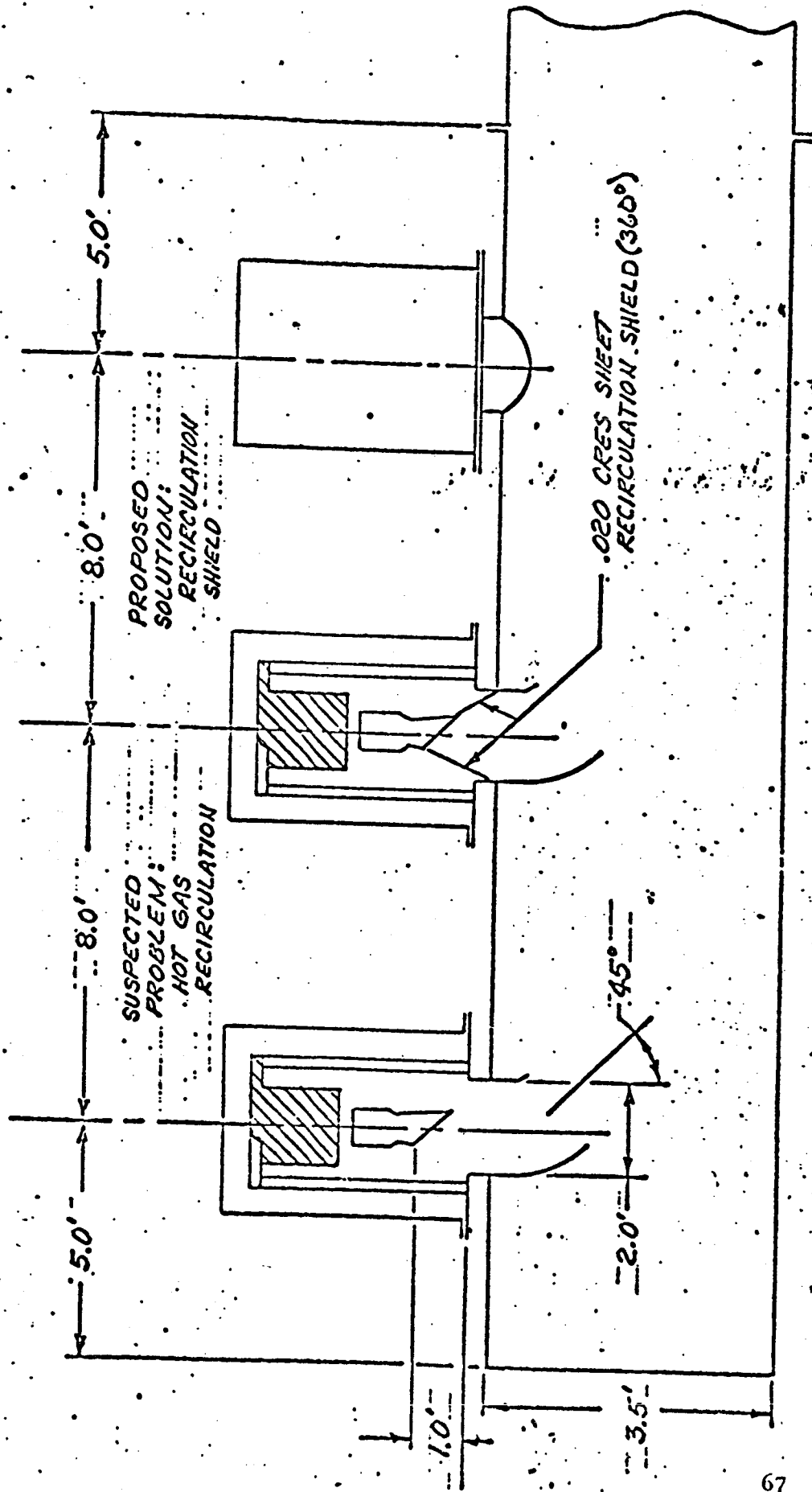
Item 31 52-52701

FAILURE ANALYSIS	
REJECTED	
W. C. Parker	11/18/64
W. C. Parker	11/19/64
RELIABILITY DEPT. 261 MCDONNELL AIRCRAFT CORP.	

A. PLEASE PROVIDE TEMP-TIME DATA CURVES FOR THIS TEST VS. THE TEMP-TIME DATA CURVES EVALUATED FROM THE R & D TESTING IN AN AMENDMENT TO THIS FAR.

FIGURE 1

Tri-Mod Altitude Test Chamber



R-15019-2

FAR 129172
20 October 1964
J. W. Sheingold

FAILURE ANALYSIS REPORT

ANALYST FILL OUT COVER SHEET ONLY

OFF IDENTIFICATION

OFF NO. 12917R	OFF BY A. Ganser NAME	896-335 DEPT. & GROUP	LOCATION CTL-III	FAILURE DATE 10-15-64
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PART IDENTIFICATION

PART NO. 20810-61	SERIAL NO. 4058233	PART NAME Thrust Chamber Assy	MFR NAME Rocketdyne
ENG/AGE MODEL NO. EE-7	ENG/AGE SERIAL NO. None	TEST/OPERATION NO. 957-090	

ANALYSIS BY

NAME W. N. Sheingold	DEPT. & GROUP 896-335	ANALYSIS DATE 1-22-65	APPROVAL [Signature]	DSN DATE 1/25/65
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FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFF, INSERT ALL APPLICABLE OFF NUMBERS IN THIS SPACE

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION

• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY

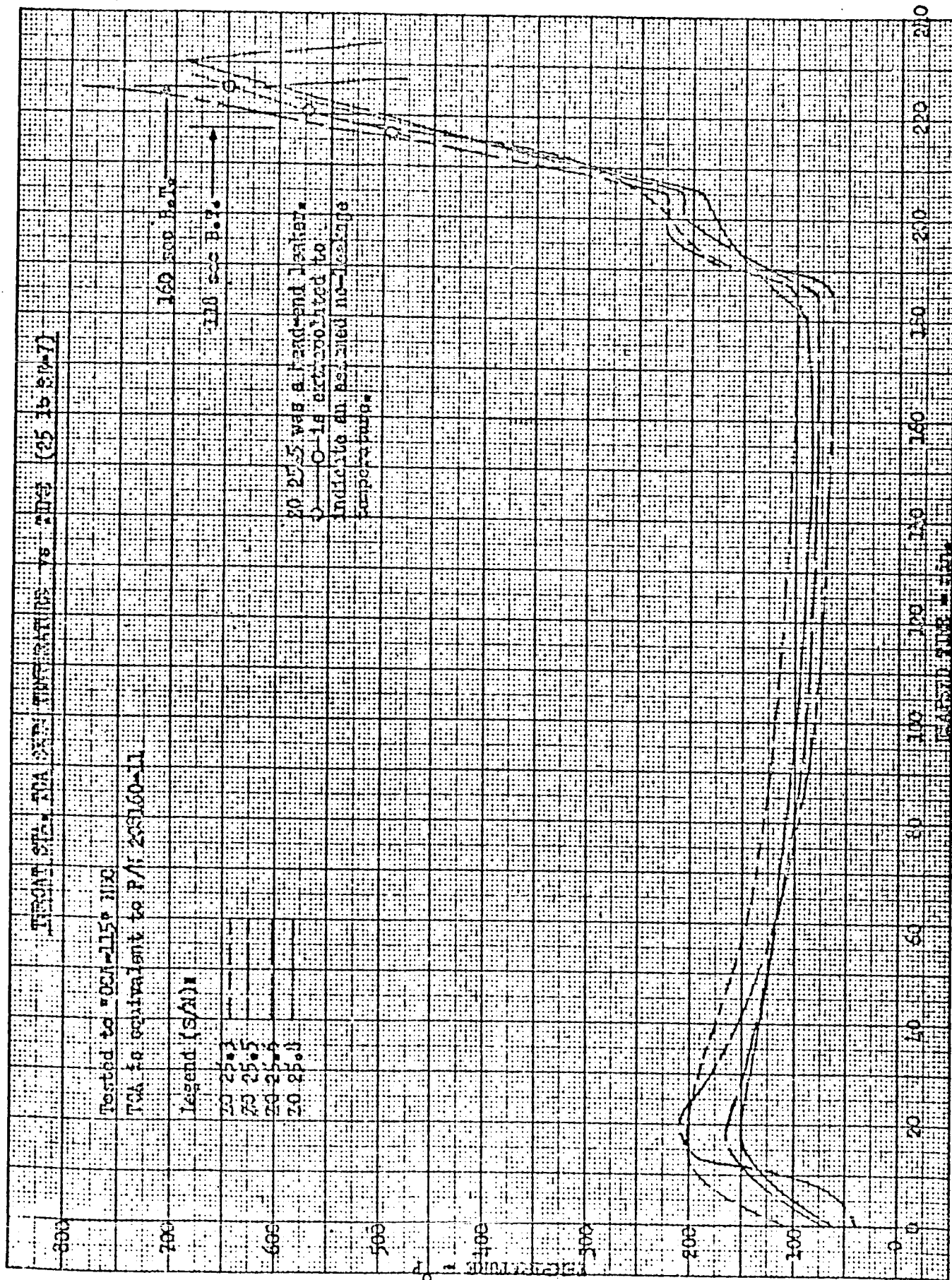
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

Para. 1, 3, and 4 - No change.

Para. 2 - In answer to questions raised concerning this FAR, Para. 2 is amended to read as follows:

"Analysis of the temperature-time data showed the outer shell skin temperatures to be greater than anticipated from previous R&D tests (see Figures 1 and 2). The R&D data was obtained from tests conducted in the large altitude simulator. Figure 2 also indicates a more rapid rate of temperature increase with time during the re-entry portion of the mission duty cycle (the most severe portion of the test)".

Post-test x-ray analysis showed the condition of the TCA to be like R&D chambers similarly tested. Sectioning of the TCA showed it to be charred through. It was thought that the recirculation of exhaust gases in the smaller altitude can (Tri-Mod) could account for the difference in temperature. To determine the extent of artificial skin heating during mission duty cycle testing as a result of hot gas recirculation in the Tri-Mod facility, a controlled test series was conducted using a 25 lb OAMS slave chamber. The test series consisted of both limited steady state and pulse testing at a simulated altitude of 170,000 feet and local ambient temperature. Four (4) strips of 0.375 inch square, 0.10 inch thick plastic packing material were suspended from each corner of the thrust measuring system housing with 4.5 inches of fiberglass string. Motion pictures taken during testing showed the four strips to fluctuate considerably during pulse testing and to stand out at an angle of 45 degrees during steady state firing. A velocity calculation was made on the basis of the steady state results and the velocity required to displace the plastic strips 45 degrees at 170,000 feet was seen to be on the order of 700 mph.

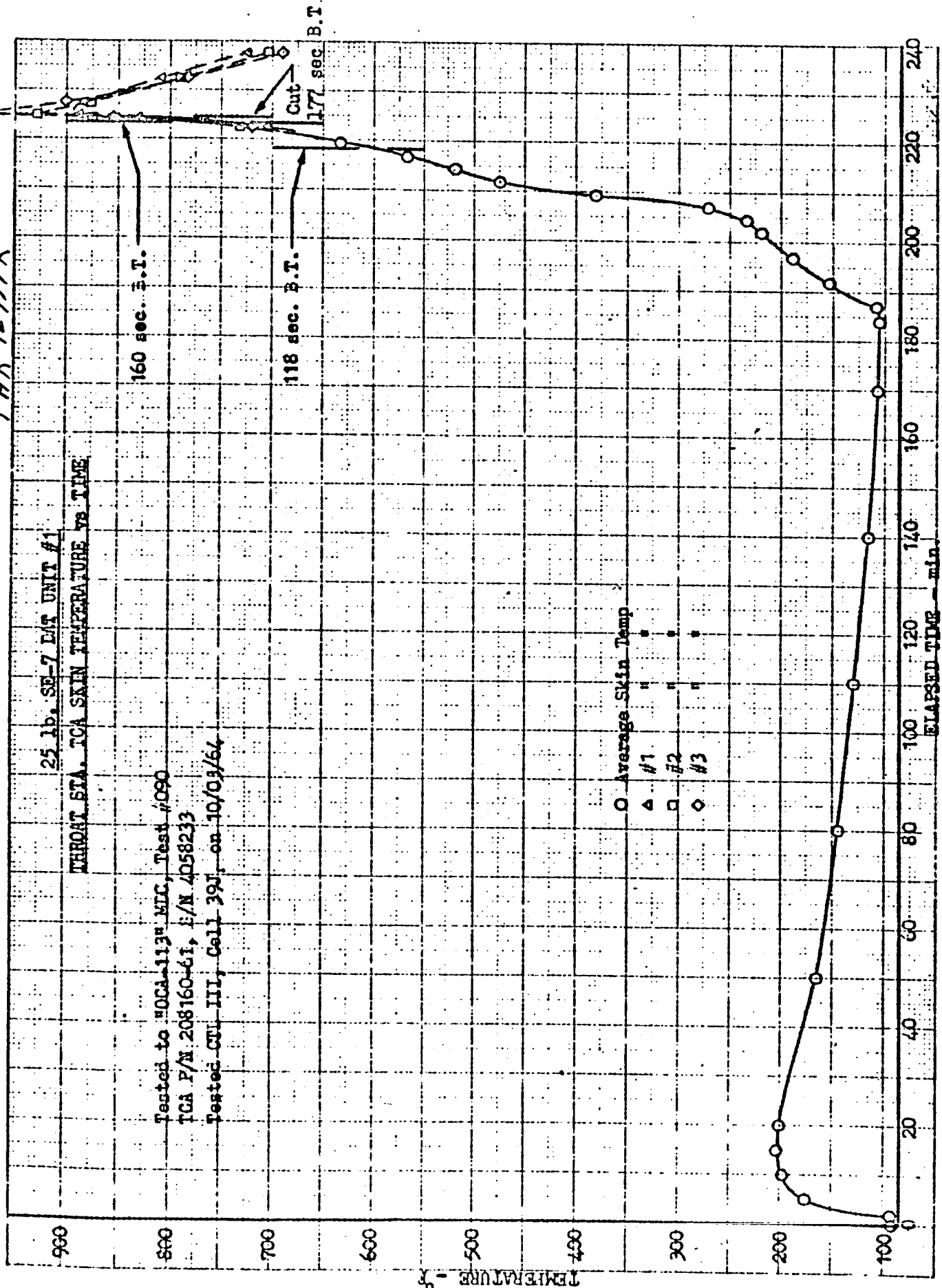


FAR 12917R

25 lb. SE-7 LMT UNIT #1

THROAT STA. TCA SKIN TEMPERATURE VS TIME

Tested to "OCA-113" MIC, Test #090
TCA P/N 208160-61, E/N 4058233
Tested CTL III, Cell 39J, on 10/03/64



R-15019-2
Fig 2

Q-1031 52-52701

FAILURE ANALYSIS	
ACCEPTED	
A. J. Goshen	2/15/65
Goshen	3/15/65
RELIABILITY DEPT. 881 McDONNELL-DOUGLAS CORP.	

RCW

47 4 71

7

U OPERATION

-PART CHANGE

☐ TIME ☐ TO
EXPIRED DIRECTED

PROGRAM

LOCATION

GE 1111
DET T-7

$$\frac{5.74}{11.}$$

№ 129243

PART REPLACEMENT

1 IDENTIFICATION		2 TEST TYPE		3 GROUP RESP. CODE		4 PA. CODE		5 EF		6 AF		7 CF		8 FC		9 24 LEAK		10 CONTAM.		11 PROP. SYSTEM		12 35	
13 36 NTH		14 COMP		15 40 ASSY		16 RS-2		17 CD		18 46		19		20		21		22		23 65 DELETE		24 70	
1 REPLACEMENT PART NO.		15 REPLACEMENT S/N		22 NAME		25 TYPE		31 MFR.		33		78		G									
16 INSTALLATION PART NO.		50 CONFIG. CODE		57 NAME		60 GR. RESP.		CH		CL		M		R		R-15019-2		78		80			

FAILURE ANALYSIS REPORT

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO. 12921R	OFR BY R. Cole NAME	896-388 DEPT. & GROUP	LOCATION CTL-III	FAILURE DATE 1-16-65
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PART IDENTIFICATION

PART NO. 1107559	SERIAL NO. 110511160	PART NAME Oxid. Solenoid Valve	MFR. NAME Rocketdyne
ENG/AGE MODEL NO. SE-7 DAT 208160-61	ENG/AGE SERIAL NO. 11058232	TEST/OPERATION NO. 207510-401	para. 7.2.3.1

ANALYSIS BY

NAME R. McClintock	DEPT. & GROUP 896-394	ANALYSIS DATE 1-28-65	APPROVAL <i>ASM/acting</i> 2-3	DSN DATE
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FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
 • STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
 • BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE.

1. History

The NTO TCA valve was reportedly stuck closed during a 150°F pulsing test. The low temperature environmental conditions were changed 3 times in order to improve the environmental atmosphere. The first system was composed of a salt brine solution leak line which was wrapped in aluminum foil and drained into a burlap wrapped propellant line to the top of the injector. Thermocouples were attached externally to the NTO valve inlet and to the top center of the injector. Cooling in this method created dry spots which were noted to have considerably lower temperatures than the wet solution areas. To remedy the dry spot problem, the area between the injector and the valve was potted with paraffin for the alcohol-water system but was found to be of little value so the paraffin was removed. The second system was an alcohol-water solution using the same test setup. A thermocouple was added to the NTO valve seat. Both the first and second systems were considered inadequate in that it was extremely difficult to control the temperatures. A third system was tried in which an environmental chamber was placed around the inlet lines and down over the TCA to the throat area. A purge line was plumbed into the chamber and vented a mixture of GN₂ and LN₂ vapor at low pressure. This system exhibited very steady temperature conditions, but the DAT TCA was not tested under this latter system.

2. Analysis

The tests (runs #20 through #31) were reviewed to study the problem area. It was observed that usually the first 2 or 3 pulses were normal and then the NTO flow would taper off in successive pulses to no flow.

An R & D TCA was used in runs #23 through #31 which exhibited the same results as the DAT TCA tests. Those verification tests indicated that a problem existed within the facility rather than the TCA NTO valve.

An investigation of the facility revealed a strong probability that the NTO propellant was freezing. These areas were: (1) loss of NTO flow on the oscillographs, (2) difficulty in controlling the environmental temperature, and (3) the standardization for temperature calibration was found off 4 degrees. (NTO freezes at 11.84°F).

The TCA was placed in an environmental chamber and temperature was lowered and stabilized at 18°F. The NTO propellant valve was pressurized to 360 psig GN₂. The valve was actuated 3 times each with 26, 30 and 22 volts with no indication of malfunctioning. An additional 10 cycles were completed with the same results. The NTO valve was checked for leakage and found satisfactory (<0.1 sec Helium/min).

3. Conclusions

The NTO propellant froze as a result of poorly controlled environmental temperature and thus NTO flow ceased.

4. Corrective Action

Re-calibrate the temperature recording system and use the third system outlined in the 1. History to test the DAT TCA.

Above corrective action was implemented and the "low temperature impulse signal width test" was successfully completed on 29-30 January 1965.

FAILURE ANALYSIS	
ACCEPTED REJECTED	
<i>G. Parker</i>	2/17/65
<i>G. Parker</i>	2/17/65
RELIABILITY DEPT. 281 McCONNELL AIRCRAFT CORP.	

Operation and Failure Report ROCKETDYNE

☒ FAILURE ☐ OPERATION
☒ FAILED ITEM ☐ TIME EXPIRED ☐ TO DEFECTED

PROGRAM: DAT SE-7
LOCATION: C-IV
No: 12954R

PART IDENTIFICATION

1 PART NO 202160-61		2 PART NAME 25 LB. TCH-GEMS	
3 SERIAL NO 9057532	4 MFG. NAME ROCKETDYNE	5 MFR. CODE 7102	6 REF. DESIG.
7 NEXT ASSY PART NO. NONE	8 NEXT ASSY SERIAL NONE	9 NEXT ASSY NAME NONE	
10 MISSILE SERIAL NO.	11 ENG/AGE MODEL NO. SE-7	14 SYSTEM CODE	
12 REJ. TAG NO.	13 ENG/AGE SERIAL NO.	15 COMPONENT CODE	
		16 HARDWARE CODE	

PART DISPOSITION

PART REPLACEMENT

1 <input type="checkbox"/> REPAIRED IN PLACE	1 <input type="checkbox"/> IDENTICAL ITEM
2 <input type="checkbox"/> REPAIRED & RE-INSTALLED	2 <input type="checkbox"/> SUBSTITUTE PART
3 <input type="checkbox"/> ADJUSTED	3 <input type="checkbox"/> NONE
4 <input type="checkbox"/> ELIMINATED	4 <input checked="" type="checkbox"/> NONE AVAILABLE
5 <input type="checkbox"/> CONDEMNED	37 REPLACEMENT PART NO.
6 <input type="checkbox"/> HOLD FOR REPAIR	38 REPLACEMENT SERIAL NO.
7 <input type="checkbox"/> DEPOT REPAIR	
8 <input checked="" type="checkbox"/> FAILURE ANALYSIS	
9 <input type="checkbox"/> USED AS IS	

FAILURE/OPERATION DATA

17 FAILURE DATE 19-11-61	18 TEST OPER. DATE 19-11-61	19 TEST OPER. NO. 957/126	20 ITEMS 1
21 PROCEDURE SPEC. & PARAGRAPH 202160-401 / 7.3.2			
22 FB	23 FAIL. TYPE	26 FAIL. CODE	27 SECONDS 118
23 EV	29 MONTHS 7	30 INITIAL REPORT NO. NONE	28 STARTS 1746
24 NC	31		
32 OPERATION REPORTED OR IN PROGRESS			33
A <input type="checkbox"/> COMP/ASSY TEST B <input type="checkbox"/> FINAL ENG. ASSY. C <input type="checkbox"/> ELEC. MECH. CHECK D <input type="checkbox"/> ACCEPT. R&D TEST E <input type="checkbox"/> STORAGE F <input type="checkbox"/> SHIPPING G <input type="checkbox"/> RECEIVING INSP.			H <input type="checkbox"/> MAINTENANCE I <input type="checkbox"/> LEAK & FUNCTION J <input type="checkbox"/> SIM. LAUNCH K <input type="checkbox"/> MISSILE ACCEPT. L <input checked="" type="checkbox"/> STAT. MISS. TEST M <input type="checkbox"/> PROPEL. LOADING N <input type="checkbox"/> PERIODIC INSP.
34 TIME PERIOD (ACCEPT R&D/STATIC TEST ONLY)			35
1 <input type="checkbox"/> PRE-TEST			
2 <input checked="" type="checkbox"/> TEST			
3 <input type="checkbox"/> POST-TEST			

REPORTED BY

42 NAME DEAFINGER	43 GROUP 388	44 SUPPLEMENT SHEET 1 <input type="checkbox"/> YES 2 <input checked="" type="checkbox"/> NO
45 APPROVED BY [Signature]	46 ACTIVITY 7	47 STAND. AREA 957

ANALYSIS ASSIGNED TO

48 NAME PEINE	49 GROUP/30 CODE 335 AR	51 PART REQ. YES <input type="checkbox"/> NO <input checked="" type="checkbox"/>
DATE REPORT RECEIVED 19-11-61	DATE REPORT DISTRIBUTED 19-11-61	53
54 TEST OPER. NO. 1	55 1	57 NTH CODE 2
56 2	58 TAPE CODE	

DESCRIPTION OF FAILURE

25 LB. GEMS GEMINI TCH, DAT UNIT N
P. 3, FAILED TO MEET THE THROAT STA
SHELL TEMP. REQUIREMENT AT 118 SE
C. B. T. DURING THE PCA-113 MDC BY
100 DEG. THE SKIN TEMPS. WERE HIGH
THROUGHOUT THE MDC. NO INCIPIENT ME
CHANICAL FAILURE WAS OBSERVED. THE
TCH WAS TESTED WITH A CONICAL SHIEL
D EXTENDING FROM THE FACILITY EXIT
TO WITHIN 1 IN. OF THE TCH EXIT. AN
ALYSIS REQUIRED.

WHEN? WHERE? HOW MUCH? CAUSE? EFFECT? COMMENTS?

71 TEST OPER. NO. 9570126A	72	73	74	75	76	77	78	79	80
							B		
							C		
							D		
							E		
							F		
							G		

RELIABILITY ANALYSIS USE ONLY

1 IDENTIFICATION	2 TEST TYPE	3 TO GROUP RESP CODE	4 PA CODE	5 AP	6 CF	7 FC	8 LEAK	9 CONTAM.	10 PROP SYSTEM	11
12 UNIT COMP	13 ASSY	14 RS-2	15 CD	16	17	18	19	20	21	22
23 REPLACEMENT PART NO.			24 REPLACEMENT			25 NAME			26 TYPE	
27 INSTALLATION PART NO. R-15019-2			28 CONF. CODE			29 NAME			30 GR ALP	
						31 MFR			32	
						33 CH CL			34	

P. LEONARD 8134

FORM NO 12954R

• ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION Amendment #1

OFR NO. 12954R	OFR BY J. Ganger NAME	896-388 DEPT. & GROUP	LOCATION CTL-III	FAILURE DATE 11-13-64
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PART IDENTIFICATION

PART NO. 208160-61	SERIAL NO. 4057532	PART NAME Thrust Chamber Assy	MFR. NAME Rocketdyne
ENG/AGE MODEL NO. SE-7	ENG/AGE SERIAL NO.	TEST/OPERATION NO. 957-126	

ANALYSIS BY

NAME J. N. Sheingold <i>JNS</i>	DEPT. & GROUP 896-335	ANALYSIS DATE 12-23-64	APPROVAL <i>[Signature]</i>	DSN DATE
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FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE

1. Gemini 25 lb OAMS DAT Unit No. 3 failed to meet the SCD temperature requirements after 118 seconds of accumulated OCA-113 mission duty cycle firing time. The temperature recorded was 100°F greater than the allowable maximum of 550°F. The mission duty cycle test was followed by a burst pressure test with no structural failure of the TCA. Testing was conducted in the Tri-Mod test facility utilizing a heat shield as shown in Figure 1.

2. Analysis of the temperature-time data showed the outer shell skin temperature to be greater throughout the mission duty cycle than anticipated from previous R&D and DAT component testing. The temperature recorded was also in excess of that obtained in testing OAMS DAT Unit No. 1 in the Tri-Mod facility with no heat shield (Figure 2).

The failure of DAT Unit No. 1 reported under OFR 12917R was seen in analysis to be a direct result of artificial TCA skin heating caused by recirculating hot TCA exhaust gases. The corrective action recommended was to install a heat shield which would enclose the thrust chamber. It was decided, however, to install a more permanent shield which would lend itself readily to all TCA configurations. No R&D tests were conducted prior to the subject DAT test for purposes of heat shield checkout, however, two strips of plastic packing material were suspended from the thrust measuring system in a similar fashion to that described in OFR 12917R except that the strips were larger for this test.

Analysis of the motion pictures taken during the test showed these plastic strips to fluctuate during TCA pulsing. A comparison of these fluctuations with those referenced in OFR 12917R indicated that the displacements in both cases were of very nearly the same magnitude. However, since the mass of the strips was greater for the DAT Unit No. 3 test, it would require an equal or greater gas velocity to displace the strips by the amount noted. Also, the TCA exit was approximately 1.5 inches above the heat shield cone entrance possibly precipitating some exhaust "spill-over" caused by gas expansion at the TCA nozzle exit.

3. The inability of the TCA to meet the SCD temperature requirements is attributed to artificial skin heating resulting from the inability of the facility heat shield to prevent the hot TCA exhaust gases from recirculating. The motion pictures clearly showed the existence of a considerable environmental gas velocity which would not exist

FH12129542

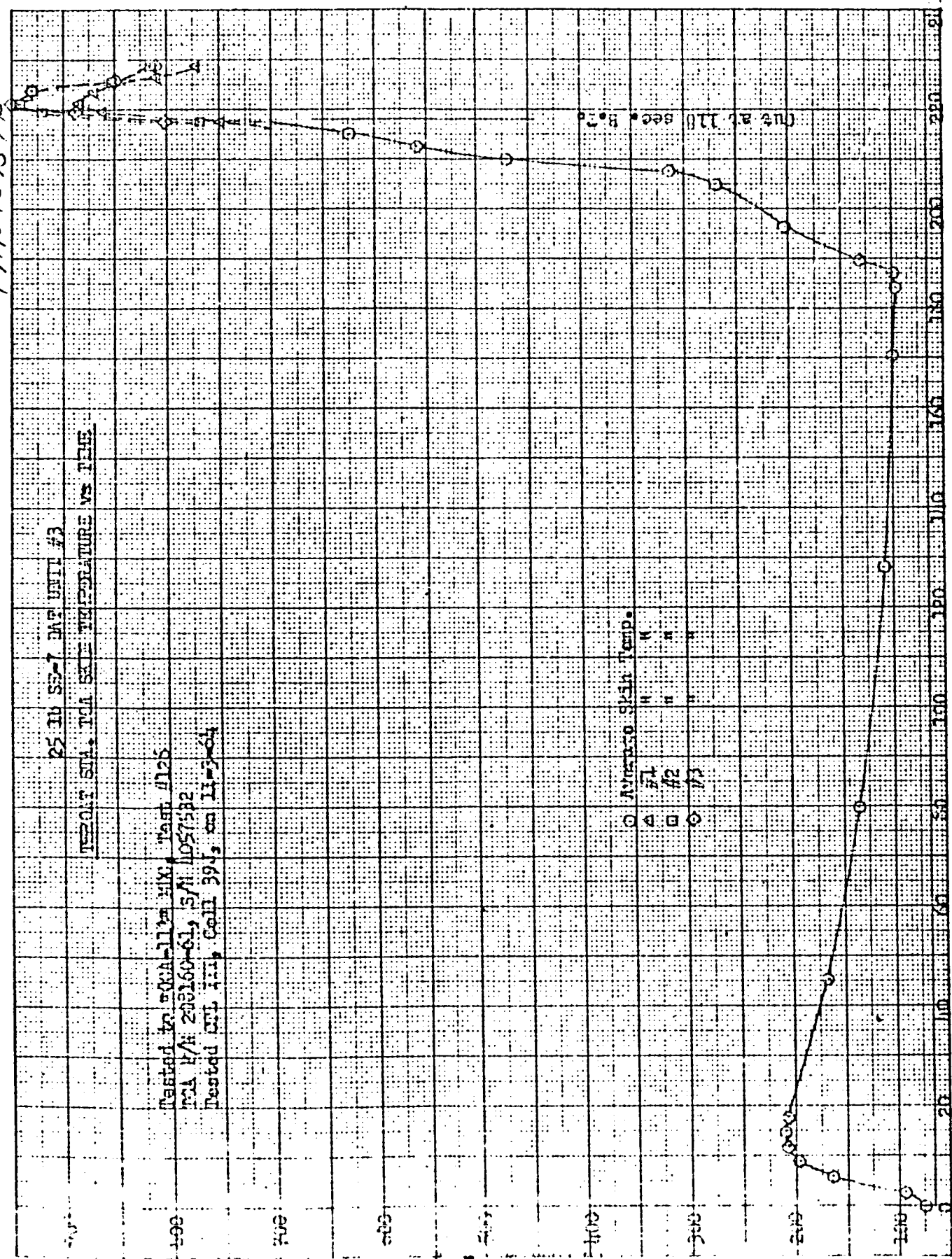
25 IN SP-7 DAT UNIT #3

TEMPERATURE VS TIME

Tested by: 200A-1124 MK, Test #125
 MA R/A 200160-61, S/N 4057532
 Tested on 11-3-64, Coll 394, on 11-3-64

Approximate Skin Temp.

O #1
 A #2
 □ #3
 ○ #4

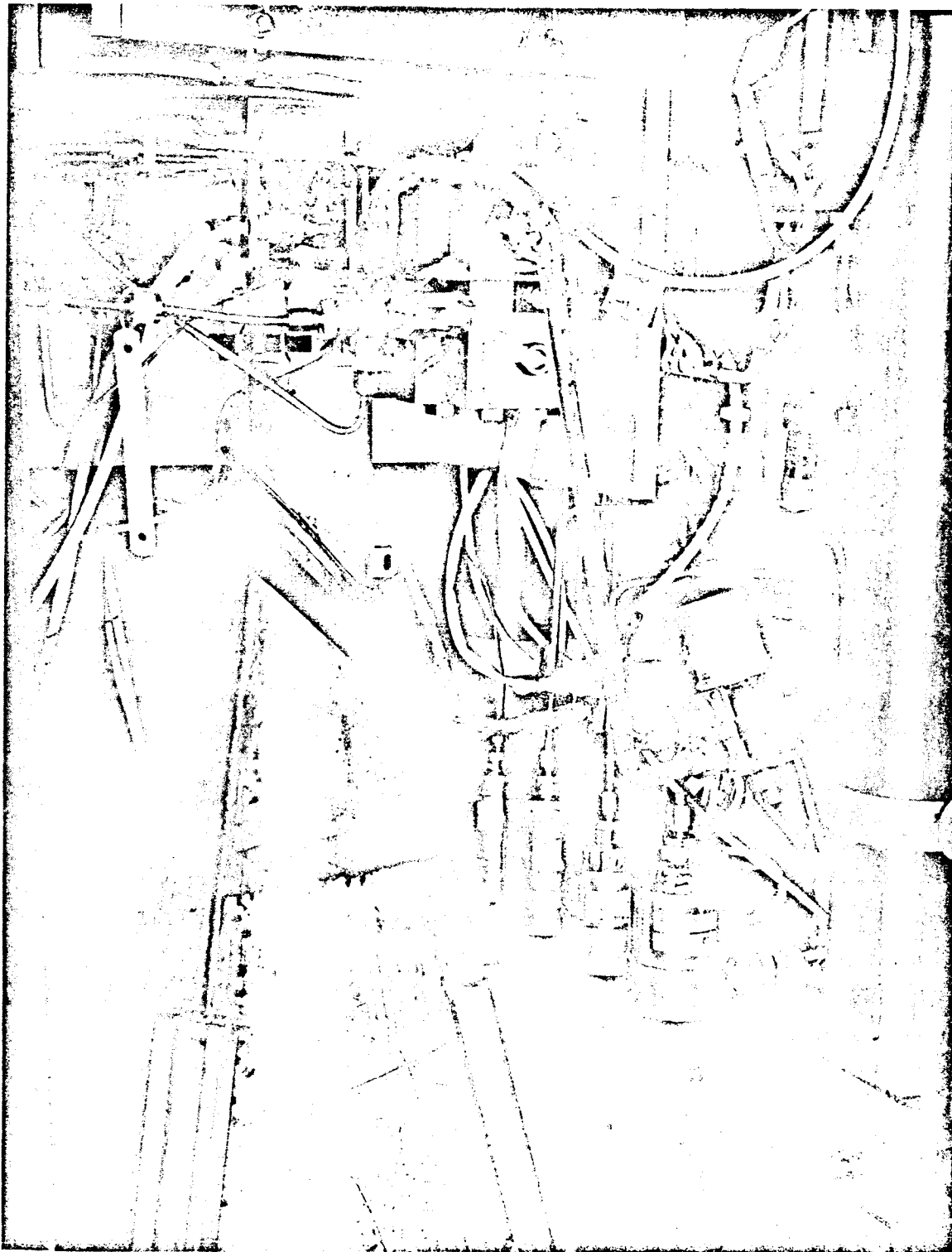


ELAPSED TIME - min



ROCKETDYNE • A DIVISION OF NORTH AMERICAN AVIATION, INC.

FAR 12954R



1HD23-11/3/64-S1A

in the Spacecraft. The TCA would have satisfactorily completed the mission duty cycle within the temperature requirements had the hot gas recirculation not occurred.

4. Tests are being conducted to determine methods of eliminating recirculation of hot exhaust gases with resultant artificial TCA skin temperatures. The final corrective action will be implemented prior to further DAT testing.

FAILURE ANALYSIS	
ACCEPTED REJECTED	
<i>W. Parker</i>	2/18/65
<i>G. Smith</i>	2/18/65
RELIABILITY DEPT. 261 MCDONNELL AIRCRAFT CORP.	

OFFR No 32656 R

ANALYST FILL OUT COVER SHEET ONLY

OFR IDENTIFICATION

OFR NO. 32656R	OFR BY W. Richtenburg NAME	896-388 DEPT. & GROUP	LOCATION CTL III	FAILURE DATE 1-9-65
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PART IDENTIFICATION

PART NO. 208160-61	SERIAL NO. 4058232	PART NAME Thrust Chamber	MFR. NAME Rocketdyne
ENG/AGE MODEL NO. SE-7	ENG/AGE SERIAL NO.	TEST/OPERATION NO. 957-011	

ANALYSIS BY

NAME R. McClintock	DEPT. & GROUP 896-394	ANALYSIS DATE 5/26/65	APPROVAL Sawling s/w	OSN DATE 11/2/65
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FAILURE ANALYSIS

IF ANALYSIS APPLIES TO MORE THAN ONE OFR, INSERT ALL APPLICABLE OFR NUMBERS IN THIS SPACE

1. HISTORY 2. ANALYSIS 3. CONCLUSIONS 4. CORRECTIVE ACTION
• STATE ITEM NUMBER AND DESCRIBE • USE EXTRA SHEETS IF NECESSARY
• BE SPECIFIC IN CORRECTIVE ACTION STATEMENT AND STATE EFFECTIVITY DATE AND/OR ENGINE SERIAL NUMBER WHERE APPLICABLE.

1. History

Per the OFR, the 25// OMS Gemini TCA, DAT Unit No. 2, failed the first 50 ms pulse during a facility checkout series when the oxidizer propellant valve (P/N 407559-S/N 4054460) opened approximately 15 ms late. The valve opened satisfactorily on the remaining 4 tests of the series. This facility checkout series was in preparation for signal width and pulse repeatability at high temperatures (160°F) testing.

Following the reported malfunction an additional 180 cycles of valve operation were performed for impulse signal width tests. Also, 2560 cycles of valve operation were performed during the Mission Duty Cycle test of 160 seconds duration.

2. Analysis

The TCA was removed from the facility for timing tests of the propellant valves. Energize time tests were performed on both valves per RA0220-354 para. 4.6. The energize time for the oxidizer valve was .0045 sec; energize time for the fuel valve was .0036 sec. Spec. allowable is .0065 sec maximum. Closing time was .0015 sec for the oxidizer valve, .0014 for the fuel valve. Spec. allowable is .002 sec maximum. The leakage test per RA0 220-354 para. 4.8 was performed on both valves and the leakage was less than 0.1 sec He/min.

Further failure analysis at this time would have required disassembly of the valve. The DAT program, however, was directed to continue with the TCA "as is" with concurrence of MAC.

A review of all of the test records for this TCA revealed that there were other occurrences of the valve having a delayed opening on the first pulse of a test series.

Examination of the test records for the first pulse revealed a 10 ms delay in NTO flow and the same amount of time delay in priming the NTO feed system. The NTO propellant valve current trace exhibited an unusual dip during the opening cycle.

A7 18 2

REF: OFR 32656R

2. Analysis (cont'd)

The TCA was received at the completion of the DAT program and the propellant valves were removed and disassembled.

Both propellant valve seats exhibited a considerable length (.020) of teflon flashing over the carrier towards the outlet due to the peening action of the ball.

There was a considerable amount of contaminant on the upstream side of the fuel valve seat. The contaminant was analyzed to the following percentages: 41% Fe, 13% Cr, 17% Ni, 19% Si, 3.4% Al, 3.0% Ag, 1.9% Mn, 0.45% Mg, 0.55% Ca, and 0.29% Cu. The Fe, Cr, and Ni could be interpreted as stainless steel and the Ni, Si, and Al are indicative of dirt. The particles ranged in size from .002 to 0.004 inches.

Upon disassembly of the NTO valve, a residue was observed on the armature outside diameter and the bobbin inside diameter. There was slight rust corrosion on the valve inlet tube area adjacent to the filter. The residue from the bobbin which appeared as a whitish crystalline substance was analyzed and revealed the following percentages: 31% Fe, 7% Cr, 1.6% Ni, 19% Si, 0.7% Mn, 0.21% Mg, 0.07% B, 0.55% Al, 0.29% Mo, 0.11% Cu, 0.016% Ag, .088% Ti, and 0.26% Ca. The analysis again shows a strong trace of stainless steel and dirt. There was an insufficient quantity for further analysis.

It is noted that these contaminants were found at the conclusion of the DAT program and can only be assumed as possibly present during the DAT program.

3. Conclusion

The TCA remained in the DAT program and the propellant valves were actuated approximately 2740 cycles subsequent to the reported failure. Therefore, it can only be concluded that the possible cause of the NTO valve failure was the residue buildup between the armature and the bobbin. Once the poppet has shuttled, this would permit the residue to readily disperse upon liquid contact, thus not hindering successive cycles. The residue was probably the result of improper or inadequate cleaning of the propellant valves after previous use with propellants. Because the NTO system was reportedly poorly primed, it would remove the possibility of the liquid propellant contacting and dispersing or dissolving the residue prior to the first actuation of the NTO valve and thus allowing normal operation.

4. Corrective Action

The decontamination procedure for the Thrust Chamber Assembly Design Approval Testing was revised and released on Feb. 26, 1965. However, the #2 OAMS TCA for DAT testing had completed its test program by this date and, therefore, the new procedure was utilized for the Spacecraft 6 and subs DAT program.

FAILURE ANALYSIS	
ACCEPTED	
W. J. Fisher	6/14/65
J. L. Hines	for R. B. Mide 6/16/65
RELIABILITY DEPT. 261	
MCDONNELL AIRCRAFT CORP.	



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APPENDIX C



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APPENDIX C

MODULE/COMPONENT LOG BOOK IDENTIFICATION
AND ACCEPTANCE TEST DATA



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THIS LOG BOOK IS TO BE USED TO RECORD THE DATA COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN.

LOG BOOK ACCEPTANCE

DAT #2

SPACE ENGINES ENGINE NO.	SPACE ENGINES QUALITY CONTROL	QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
<i>Space Engine</i> DATE <i>2 July 64</i>	<i>Space Engine</i> DATE <i>2 July 64</i>	<i>McDonnell</i> DATE <i>7-2-64</i>	<i>Whitcomb</i> DATE <i>2 July 64</i>

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SECTION I - DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II - PERFORMANCE TEST LOG

RECORDS CONTAINED IN THIS SECTION ARE PRESENTED IN ACCORDANCE WITH PERFORMANCE DATA AND SUMMARY DATA RECORDS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS THE RESPONSIBILITY OF THE USER TO ACCOMPANY THE DELIVERABLE END ITEM WITH PERFORMANCE DATA AND SUMMARY DATA RECORDS AND ACCEPTANCE.

SPACE ENGINES - SPACE ENGINES

ROCKETDYNE, INC.

LOG BOOK SPECIFICS

MCDONNELL	ITEM	ROCKETDYNE
THIS MATERIAL IS THE PROPERTY OF THE NATIONAL AERONAUTICS AND SPACE ADMINISTRATION. IT IS TO BE USED IN ANY MANNER PROHIBITED BY LAW.	LOG BOOK DATE	1 JULY 1964
Y 20161R	DWG CHG LTR	DNA
SCD52-52701-265	CONTRACT NO.	5252
DNA	GEN ORDER NO.	4058233
52-52701-265	SPEC NO.	208160-61
	SERIAL NO.	
	PART NO.	

SE-7 DELIVERABLE END ITEM - LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

~~CONFIDENTIAL~~

DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

R-15019-2

	52-52701-265 PART NO. 208160-61
FOREWORD -- SE-7 LOG BOOK	PART NAME THRUST CHAMBER, 25 LB., ASSY OF 2.0

- 1.0 LOG BOOK IDENTIFICATION
- 2.0 FOREWORD
- 3.0 CONTENTS
- 4.0 MODULE/COMPONENT ASSEMBLY LOG - SECTION I
- 4.1 CONFIGURATION AND SERIALIZATION LOG
- 4.2 PCR VERIFICATION
- 4.3 VARIATION LOG
- 4.4 REPLACEMENT LOG
- 5.0 COMPONENT ACCEPTANCE TEST LOG - SECTION II
- 5.1 COMPONENT ACCEPTANCE TEST
- 5.1.1 COMPONENT ACCEPTANCE TEST
- 5.1.2 COMPONENT ACCEPTANCE TEST
- 5.1.3 COMPONENT ACCEPTANCE TEST
- 5.2 CALIBRATED PERFORMANCE DATA
- 5.2.1 CALIBRATED PERFORMANCE DATA
- 5.2.2 CALIBRATED PERFORMANCE DATA
- 5.3 INFORMATION - CONTAMINATION

52-52701-265

PART NO. 208160-61

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PART NAME THRUST CHAMBER, 25 LB., ASSY OF

3.0

SECTION I

52-52701-265 PART NO. 208160-61

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 4.0


SE-7 MODULE / COMPONENT ASSEMBLY LOG

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	208160-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4053233	2 Q 64	634
2	208161-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4059279	2 Q 64	634
2	208166	DNA	SHELL, THRUST CHAMBER, ASSY OF	8899857		634
3	208530-11	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7039387		634
2	407559	DNA	VALVE, OXIDIZER, T/C, ASSY OF	9193579		634
2	407560	DNA	VALVE, FUEL, T/C, ASSY OF	4059525		634
91						
				DNA	SERIAL NO. 4058233	
				52-52701-265	PART NO. 208160-61	
				PART NAME	THRUST CHAMBER, 25 LB., ASSY OF	4.1

SE- 7 CONFIGURATION & SERIALIZATION LOG

22

MCR / ECP NO.	DATE	TITLE	DATE	INSP.
SE6-062	6 JAN 64	COMPONENT CLEANING; PROVISION FOR	30 JUNE 64	(N42)
SE6-064	30 JUL 63	TCA, ACCEPTANCE TESTS; REVISION OF	30 JUNE 64	(N42)
SE6-133	22 APR 64	TCA PROPELLANT VALVES; ADDITIONAL REQUIREMENTS FOR	30 JUNE 64	(N42)
SE6-139	15 APR 64	PLACEMENT OF HAYNES STELLITE #3 SAND CAST ON APPROVED MATERIAL LIST	30 JUNE 64	(N42)
SE6-144	15 APR 64	TCA INJECTORS; REDESIGN OF	30 JUNE 64	(N42)
SE6-179	16 JUN 64	TUBE STUBS; MARKING OF	30 JUNE 64	(N42)
SE6-075	4 FEB 64	MAC REPORT 8518, INCORPORATION OF	30 JUNE 64	(N42)
SE6-080	28 DEC 63	THRUST CHAMBER ASSEMBLIES, FABRICATION MATERIAL; APPROVAL OF	30 JUNE 64	(N42)
SE7-25	9 APR 63	25 LB., TCA, MOUNTING HOLES; RELOCATION OF	30 JUNE 64	(N42)
SE7-29	31 MAY 63	THRUST CHAMBER ASSY., 25#; CHANGES TO	30 JUNE 64	(N42)
SE6-227	6 MAY 64	25 LB., TCA SCD's, CHANGES TO	30 JUNE 64	(N42)
SE6-085	30 JUL 63	CUSTOMER TEST SURVEILLANCE; REQUIREMENT FOR	30 JUNE 64	(N42)
R-15019-2				
		DMA	SERIAL NO. 4058233	
		52-52701-265	PART NO. 208160-61	
SE-7 DELIVERABLE END ITEM - MCR VERIFICATION		PART NAME	THRUST CHAMBER, 25 LB., ASSY OF	4.2

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
R-15019-2				NONE THIS DATE 1 JULY 64	
				DINA SERIAL NO. 4058233 52-52701-265 PART NO. 208160-61	
SE- 7 DELIVERABLE END ITEM -- VARIATION LOG				PART NAME THRUST CHAMBER, 25 LB., ASSY OF 4.3	

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
94			NONE THIS DATE 1 JULY 64			12
			DVA SERIAL NO. 4058233 52-52701-265 PART NO. 203100-01			
SE-7 DELIVERABLE END ITEM -- REPLACEMENT LOG			PART NAME TRUST CHARGER, 25 LB., ASSY OF 4.4			

R-15019-2

R-15019-2

SECTION II

95

52-52701-265 PART NO. 208160-61

SE - 7 COMPONENT ACCEPTANCE TEST LOG

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 5.0

PERFORMANCE PARAMETERS

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>ELECTRICAL RESISTANCE TESTS</u>					
VALVE BODY TEMPERATURE	4.2				
OXIDIZER	4.2.4	DEGREES F	70 \pm 5	71	(53R)
FUEL		DEGREES F	70 \pm 5	71	(53R)
VALVE COIL RESISTANCE	4.2.5				
OXIDIZER		OHMS	42 \pm 2	40.85	(53R)
FUEL		OHMS	42 \pm 2	41.71	(53R)
CONTINUITY RESISTANCE	4.2.9				
OXIDIZER		OHMS	1.0 MAX.	C.186	(53R)
FUEL		OHMS	1.0 MAX.	0.143	(53R)
<u>DIELECTRIC STRENGTH TEST</u>	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICRO AMPS	500 MAX.	41	(53R)
FUEL	4.3.8	MICRO AMPS	500 MAX.	33	(53R)
<u>PROOF PRESSURE TEST - TCA PROPELLANT VALVES</u>	4.4				
VALVE PRESSURIZED FOR MINIMUM OF 3 MINUTES AT 500 \pm 10 PSIG	4.4.3	DNA	VERIFY	VERIFIED	(53R)
VALVE DE-PRESSURIZED AND VALVE HOUSING INSPECTED FOR DAMAGE OR DEFORMATION	4.4.4	DNA	VERIFY	VERIFIED	(53R)
PARAGRAPHS 4.4.3 AND 4.4.4 REPEATED	4.4.5	DNA	VERIFY	VERIFIED	(53R)

R-15019-2

 REVISION
 NC
 AMENDMENT
 #3

 SPECIFICATION NUMBER
 RA0220-354

 DNA
 52-52701-265
 SERIAL NO. 4058233
 PART NO. 208160-61

SE-7 COMPONENT ACCEPTANCE TEST

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST - TCA PROPELLANT VALVES (CONTINUED)					
CONFORMANCE TO PARAGRAPHS 4.4.3, 4.4.4, AND 4.4.5 VERIFIED					
OXIDIZER		DNA	VERIFY	VERIFIED	AMR 53R
FUEL		DNA	VERIFY	VERIFIED	AMR 53R
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFYQ	VERIFIED	AMR 53R
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	AMR 53R
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	AMR 53R
FUNCTIONAL TEST - TCA PROPELLANT VALVES					
OPENING RESPONSE TIME	4.6				
OXIDIZER	4.6.8	SEC.	.0065 MAX.	.0036	AMR 53R
FUEL		SEC.	.0065 MAX.	.004	AMR 53R
CLOSING RESPONSE TIME	4.6.10				
OXIDIZER		SEC.	.002 MAX.	.0014	AMR 53R
FUEL		SEC.	.002 MAX.	.0017	AMR 53R
CLOSING DROP OUT VOLTAGE	4.6.13				
OXIDIZER		VOLT(DC)	1 MIN.	2.5	AMR 53R
FUEL		VOLT(DC)	1 MIN.	1.5	AMR 53R
REVISION A. ELEMENT #3	SPECIFICATION NUMBER	DNA	SERIAL NO.	4058233	
1.C	RA0220-354	52-52701-265	PART NO.	208160-61	
SE - 7 COMPONENT ACCEPTANCE TEST		PART NAME	THRUST CHAMBER, 25., ASSY OF		5.1.1

PERFORMANCE PARAMETERS							PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>LEAKAGE TEST - TCA PROPELLANT VALVES</u>							4.8				
SEAT LEAKAGE RATE							4.8.16				
OXIDIZER							4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	(142)
FUEL							4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	(142)
<u>PRE-TEST DATA</u>											
DRY WEIGHT							4.1.3	LB.	DNA	3.35	(142)
NOZZLE EXIT DIAMETER SECTION A-A								INCH	DNA	2.218	(142)
THROAT DIAMETER SECTION A-A								INCH	DNA	.358	(142)
B-B								INCH	DNA	.358	(142)
C-C								INCH	DNA	.358	(142)
D-D								INCH	DNA	.358	(142)
<u>POST HOT-FIRE DATA</u>							4.5				
<u>PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER</u>							4.5.8	DNA	VERIFY	VERIFIED	(142)
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED							4.5.8	DNA	VERIFY	VERIFIED	(142)
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED							4.5.8	DNA	VERIFY	VERIFIED	(142)
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION							4.5.14	DNA	VERIFY	VERIFIED	(142)
REVISION		AMENDMENT		SPECIFICATION NUMBER		DNA		SERIAL NO.		4058233	
NC		#3		RA0220-354		52-52701-265		PART NO.		208160-61	
SE - 7 COMPONENT ACCEPTANCE TEST				PART NAME		THRUST CHAMBER, 25 LB., ASSY OF		5.1.2			

PERFORMANCE PARAMETERS		PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
R-15019-2	<u>LEAK TEST--WELDED JOINTS</u>					
	JOINT LEAKAGE RATE					
	OXIDIZER		SCC/SEC	10 ⁻⁶ MAX.	LESS THAN 10 ⁻⁶	142
	FUEL		SCC/SEC	10 ⁻⁶ MAX.	LESS THAN 10 ⁻⁶	142
	<u>LEAKAGE TEST-TCA PROPELLANT VALVES</u>					
	SEAT LEAKAGE RATE					
	OXIDIZER		SCC/SEC	2.21 MAX.	LESS THAN 0.1	142
	FUEL		SCC/SEC	2.21 MAX.	LESS THAN 0.1	142
	DRY WEIGHT		LB.	DNA	3.15	142
	NOZZLE EXIT DIAMETER		INCH	DNA	2.233	142
	SECTION A-A					
	THROAT DIAMETER		INCH	DNA	.350	142
	SECTION A-A					
	B-B		INCH	DNA	.3497	142
	C-C		INCH	DNA	.350	142
	D-D		INCH	DNA	.3498	142
	DRY WEIGHT (DELIVERABLE)		LB.	DNA	3.09	142
	4.17.5					
	4.17.6					
	4.17.8					
	4.17.9					
	4.8.16					
	4.8.17					
	4.8.17					
	4.17.1					
	4.18.1					
	4.18.2					
	4.18.1					
	4.18.1					
	4.18.1					
SPECIFICATION NUMBER		AMENDMENT	REVISION	SERIAL NO. 4058233		
RA0220-354		#3	NC	PART NO. 208160-61		
SE - 7 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF			5.1.3	

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 158 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NFL	(142)
CELL LOCATION	-	-	-	-	-	379	(142)
CELL NUMBER	-	-	-	-	-	1-C	(142)
TEST DATE	-	-	-	-	-	15 JUN 64	(142)
TEST DURATION	SEC.	2 MIN.	-	-	-	3.0	(142)
ENVIRONMENTAL PC	PSIA	.16 MAX.	-	-	-	.0622	(142)
AMBIENT PRESSURE	PSIA	DNA	-	-	-	12.04	(142)
AMBIENT TEMPERATURE	°F	DNA	-	-	-	63.0	(142)
TIME OF DATA SLICE-START	SEC.	DNA	-	-	-	2.8	(142)
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	(142)
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	53.5	(142)
FUEL TEMPERATURE	°F	DNA	-	-	-	118.5	(142)
OXIDIZER DENSITY	LB/FT ³	DNA	-	-	-	91.85	(142)
FUEL DENSITY	LB/FT ³	DNA	-	-	-	54.65	(142)
REVISION N/C	AMENDMENT 1/3	SPECIFICATION NUMBER * RA0220-354	DNA	SERIAL NO. 52-52701-265	1058233	PART NO. 203160-61	
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.2		

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 159 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NFL	(142)
OXIDIZER INLET PRESSURE	PSIA	292 ± 10	-	-	-	294.2	(142)
FUEL INLET PRESSURE	PSIA	292 ± 10	-	-	-	289.8	(142)
OXIDIZER FLOWRATE	LB/SEC.	DNA	-	-	-	.0462	(142)
FUEL FLOWRATE	LB/SEC.	DNA	-	-	-	.0351	(142)
THRUST	LB.	DNA	-	-	-	23.3	(142)
MIXTURE RATIO	O/F	DNA	-	-	-	1.32	(142)
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	287.	(142)
INJECTOR END Pc	PSIA	DNA	-	-	-	135.7	(142)
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5409.	(142)
THROAT DIAMETER	IN.	DNA	-	-	-	.358	(142)
FUEL ORIFICE DIAMETER	IN.	DNA	-	-	-	.04700	(142)
OXIDIZER ORIFICE DIAMETER	IN.	DNA	-	-	-	.03945	(142)
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	-	-	-	3.0	(142)
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	238.	(142)
FUEL SAMPLE NUMBER	-	-	-	-	-	239.	(142)
REVISION N/C	AMENDMENT #3	SPECIFICATION NUMBER * RA0220-354	DNA SERIAL NO. 4058233 52-52701-265 PART NO. 208160-61				
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF 5.2.1				

[illegible]

THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

	LIMITS	ACTUAL COUNT	
		MMH - FUEL	ACTUAL COUNT
		DNA	NTD - OXID
< 10	*		DNA
10 - 25	100	63	71
25 - 50	20	7	11
50 - 100	5	5	3
100 - 300	1	1	0
300 - 1000	0	0	0
> 1000	0	0	0
FIBERS 300 - 3000	0	0	0
FIBERS > 3000	0	0	0

* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG)..

CLASS h

INSP. 

SPECIFICATION NUMBER A 015-003	REVISION B	AMENDMENT #1	52-52701-265	PART NO.	208160-61
	SE-7 INFORMATION - CONTAMINATION		PART NAME	THRUST CHAMBER, 25 LB., ASSY OF 5.3	

~~CONFIDENTIAL~~

SCD 52-52701-265 (S/N 4058232)

"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE DAT #4 (DRD #4)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	MC DONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
<i>W. J. McManis</i> DATE 15 JULY 1964	<i>S. N. Quisenberry</i> DATE 15 JULY 1964	<i>Harold D. Shumaker</i> DATE 15 JULY 1964	<i>Jim C. Zippore</i> DATE 15 JULY 1964

CONTENTS

SECTION I - DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION DATA, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II - ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKETDYNE AND USING AGENCIES.

GROUP-4 -
Downgraded at 3 year interval
Declassified after 12 years
ROCKETDYNE - SPACE ENGINES
A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

ITEM	ROCKETDYNE
HIS MATERIAL CONTAINS INFORMATION OF THE UNITED STATES WITHIN THE MEANING OF THE PATENT LAWS OF THE U.S. C. SECTIONS 793 AND 795. NO DISSEMINATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS FORBIDDEN BY LAW.	AFFECTING THE UNITED STATES PATENT LAWS OF THE U.S. C. SECTIONS 793 AND 795. NO DISSEMINATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS FORBIDDEN BY LAW.
LOG BOOK DATE	15 JULY 64
DWG CHG LTR	DNA
CONTRACT NO.	5252
GEN ORDER NO.	
SPEC NO.	
SERIAL NO.	4058232
PART NO.	208160-61

SE-7 DELIVERABLE END ITEM - LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.0

~~CONFIDENTIAL~~

DELIVERABLE END ITEM (DEI)

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM (DEI) AS SPECIFIED HEREIN BY SERIAL NO. AND PART NO. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

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THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

208160-61

52-52701-265

PART NO.

FOREWORD -- SE-7 LOG BOOK

PART NAME THURST CHAMBER, 25 LB. ASSY OF

2.0

1.0	LOG BOOK IDENTIFICATION
2.0	FOREWORD
3.0	CONTENTS
4.0	MODULE/COMPONENT ASSEMBLY LOG - SECTION I
4.1	CONFIGURATION AND SERIALIZATION LOG
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4.3	VARIATION LOG
4.4	REPLACEMENT LOG
5.0	COMPONENT ACCEPTANCE TEST LOG - SECTION II
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5.1.1	COMPONENT ACCEPTANCE TEST
5.1.2	COMPONENT ACCEPTANCE TEST
5.1.3	COMPONENT ACCEPTANCE TEST
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5.2.1	CALIBRATED PERFORMANCE DATA
5.2.2	CALIBRATED PERFORMANCE DATA
5.3	INFORMATION - CONTAMINATION

52-52701-265 PART NO. 208160-61

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 3.0

CONTENTS -- SE-7 LOG BOOK

SECTION I


52-52701-265 PART NO. 208160-61

4.0

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

SE-7 MODULE / COMPONENT ASSEMBLY LOG

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MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
MAC NRR #55346	TCA	208160-61	4058232	<p>DISCREPANCY:</p> <p>CONDITION A: THE 1.00 \pm .06 \pm .06 DIM. FROM THE T.C.A. CENTERLINE TO THE BOTTOM SURFACE OF THE ELECTRICAL CONNECTOR ON THE OXID. SIDE CHECKS FROM .926 TO .936. REF. ZONE 9 (END VIEW) B/P 208160 - E0153371.</p> <p>DISPOSITION:</p> <p>ACCEPTABLE TO USE.</p>	
				<p>DNA SERIAL NO. 4058232</p> <p>52-52701-265 PART NO. 208160-61</p>	
SE- 7 DELIVERABLE END ITEM - VARIATION LOG				PART NAME THRUST CHAMBER, 25 LB., ASSY OF	4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE - 15 JULY 1964			(21)
			DNA	SERIAL NO.	L058232	
			52-52701-265	PART NO.	208160-61	
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG			PART NAME		THRUST CHAFTER, 25 LB., ASSY OF 4.4	

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SECTION II

SE - 7 COMPONENT ACCEPTANCE TEST LOG

52-52701-265

PART NO.

208160-61

PART NAME

THRUST CHAMBER, 25 LB., ASSY OF

5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>ELECTRICAL RESISTANCE TESTS</u>					
VALVE BODY TEMPERATURE	4.2				72
OXIDIZER	4.2.4	DEGREES F	70 ± 5		72
FUEL		DEGREES F	70 ± 5		
VALVE COIL RESISTANCE	4.2.5	OHMS	42 ± 2	LO.460	
OXIDIZER		OHMS	42 ± 2	LO.820	
FUEL					
CONTINUITY RESISTANCE	4.2.9	OHMS	1.0 MAX.	.053	
OXIDIZER		OHMS	1.0 MAX.	.060	
FUEL					
<u>DIELECTRIC STRENGTH TEST</u>	4.3				
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICRO AMPS	500 MAX.	31	
FUEL	4.3.8	MICRO AMPS	500 MAX.	34	
<u>PROOF PRESSURE TEST - TCA PROPELLANT VALVES</u>	4.4				
VALVE PRESSURIZED FOR MINIMUM OF 3 MINUTES AT 500 ± 10 PSIG	4.4.3	DNA	VERIFY	VERIFIED	
VALVE DE-PRESSURIZED AND VALVE HOUSING INSPECTED FOR DAMAGE OR DEFORMATION	4.4.4	DNA	VERIFY	VERIFIED	
PARAGRAPHS 4.4.3 AND 4.4.4 REPEATED	4.4.5	DNA	VERIFY	VERIFIED	
SPECIFICATION NUMBER		DNA	SERIAL NO.	4058232	
* N/C	AMEND. # 3	52-52701-265	PART NO.	208160-61	
SE-7 COMPONENT ACCEPTANCE TEST		PART NAME THRUST CHAMBER, 25 LB., ASSY OF			5.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST - TCA PROPELLANT VALVES (CONTINUED)					
CONFORMANCE TO PARAGRAPHS 4.4.3, 4.4.4, AND 4.4.5 VERIFIED					
OXIDIZER		DNA	VERIFY	VERIFIED	(21)
FUEL		DNA	VERIFY	VERIFIED	(21)
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFYQ	VERIFIED	(21)
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	(21)
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	(21)
FUNCTIONAL TEST - TCA PROPELLANT VALVES					
OPENING RESPONSE TIME	4.6				
OXIDIZER		SEC.	.0065 MAX.	.0012	(21)
FUEL	4.6.8	SEC.	.0065 MAX.	.0010	(21)
CLOSING RESPONSE TIME	4.6.10				
OXIDIZER		SEC.	.002 MAX.	.0016	(21)
FUEL		SEC.	.002 MAX.	.0018	(21)
CLOSING DROP OUT VOLTAGE	4.6.13				
OXIDIZER		VOLT(DC)	1 MIN.	1.3	(21)
FUEL		VOLT(DC)	1 MIN.	1.3	(21)
*N/C AMEND. # 3	SPECIFICATION NUMBER * RA0220-354	DNA	SERIAL NO. 52-52701-265	1058232 PART NO. 208160-61	
SE - 7 COMPONENT ACCEPTANCE TEST		PART NAME	THRUST CHAMBER, 25., ASSY OF		5.1.1

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>LEAKAGE TEST - TCA PROPELLANT VALVES</u>					
SEAT LEAKAGE RATE	4.8	SCC/MIN	2.21 MAX.	LESS THAN 0.1	(21)
OXIDIZER	4.8.16				
FUEL	4.8.17	SCC/MIN	2.21 MAX.	LESS THAN 0.1	(21)
<u>PRE-TEST DATA</u>					
DRY WEIGHT	4.1.3	LB.	DNA	3.10	(21)
NOZZLE EXIT DIAMETER SECTION A-A		INCH	DNA	2.295	(21)
THROAT DIAMETER SECTION A-A		INCH	DNA	.358	(21)
B-B		INCH	DNA	.358	(21)
C-C		INCH	DNA	.358	(21)
D-D		INCH	DNA	.358	(21)
<u>POST HOT-FIRE DATA</u>					
PROOF PRESSURE AND LEAKAGE TEST - THRUST CHAMBER	4.5				
CHAMBER PRESSURIZED FOR A MINIMUM OF 5 MINUTES AT 392 ± 10 PSIG. NO LEAKAGE DETECTED	4.5.8	DNA	VERIFY	VERIFIED	(21)
CHAMBER DE-PRESSURIZED AND PARAGRAPH 4.5.8 REPEATED	4.5.8	DNA	VERIFY	VERIFIED	(21)
TCA INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.5.14	DNA	VERIFY	VERIFIED	(21)
* N/C	AMEND. # 3				
SE - 7 COMPONENT ACCEPTANCE TEST	SPECIFICATION NUMBER RA 0220-354	DNA	SERIAL NO. 4058232	PART NO. 208160-61	5.1.2

PERFORMANCE PARAMETERS		PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
116	LEAK TEST--WELDED JOINTS					
	JOINT LEAKAGE RATE	4.17.5	SCC/SEC	10^{-6} MAX.	2.6×10^{-8}	(2)
	OXIDIZER	4.17.6				
	FUEL	4.17.8	SCC/SEC	10^{-6} MAX.	1.6×10^{-8}	(2)
	LEAKAGE TEST-TCA PROPELLANT VALVES					
	SEAT LEAKAGE RATE	4.17.9				
	OXIDIZER	4.8.16				
	FUEL	4.8.17	SCC/SEC	2.21 MAX.	LESS THAN 0.1	(2)
		4.8.17	SCC/SEC	2.21 MAX.	LESS THAN 0.1	(2)
	DRY WEIGHT	4.17.1	LB.	DNA	3.14	(2)
	NOZZLE EXIT DIAMETER					
	SECTION A-A		INCH	DNA	2.255	(2)
	THROAT DIAMETER	4.18.1				
	SECTION A-A		INCH	DNA	.358	(2)
R-1019-2	B-B		INCH	DNA	.358	(2)
	C-C		INCH	DNA	.358	(2)
	D-D		INCH	DNA	.358	(2)
	DRY WEIGHT (DELIVERABLE)	4.18.2	LB.	DNA	3.09	(2)
SPECIFICATION NUMBER		RA0220-354				
REVISION		N/C				
AMENDMENT		# 3				
DINA				SERIAL NO.	L058232	
52-52701-265				PART NO.	208160-61	
PART NAME		THRUST CHAMBER, 25 LB., ASSY OF				5.1.3
SE - 7 COMPONENT ACCEPTANCE TEST						

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 217 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NTF	(10)
CELL LOCATION	-	-	-	-	-	1-B	(10)
CELL NUMBER	-	-	-	-	-	379	(10)
TEST DATE	-	-	-	-	-	15 JUN 64	(10)
TEST DURATION	SEC.	2 MIN.	-	-	-	3.0	(10)
ENVIRONMENTAL P _c	PSIA	.16 MAX.	-	-	-	.0644	(10)
AMBIENT PRESSURE	PSIA	DNA	-	-	-	12.04	(10)
AMBIENT TEMPERATURE	°F	DNA	-	-	-	63.0	(10)
TIME OF DATA SLICES-START	SEC.	DNA	-	-	-	2.8	(10)
TIME OF DATA SLICE-END	SEC.	DNA	-	-	-	2.8	(10)
OXIDIZER TEMPERATURE	°F	DNA	-	-	-	56.0	(10)
FUEL TEMPERATURE	°F	DNA	-	-	-	119.5	(10)
OXIDIZER DENSITY	LB/FT ³	DNA	-	-	-	91.81	(10)
FUEL DENSITY	LB/FT ³	DNA	-	-	-	54.26	(10)
* N/C AMEND. # 3		SPECIFICATION NUMBER * RA0220-354	DNA	SERIAL NO. 4058232	PART NO. 52-52701-265	PART NO. 209160-61	
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF				5.2

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CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN TEST DATA	RUN TEST DATA	RUN TEST DATA	RUN 217 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	-	-	-	NFL	(50)
OXIDIZER INLET PRESSURE	PSIA	292 ± 10	-	-	-	288.7	(50)
FUEL INLET PRESSURE	PSIA	292 ± 10	-	-	-	290.6	(50)
OXIDIZER FLOWRATE	LB/SEC.	DNA	-	-	-	.0466	(50)
FUEL FLOWRATE	LB/SEC.	DNA	-	-	-	.0358	(50)
THRUST	LB.	DNA	-	-	-	23.8	(50)
MIXTURE RATIO	O/F	DNA	-	-	-	1.30	(50)
SPECIFIC IMPULSE	SEC.	DNA	-	-	-	289.	(50)
INJECTOR END Pc	PSIA	DNA	-	-	-	138.1	(50)
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	-	-	-	5431.	(50)
THROAT DIAMETER	IN.	DNA	-	-	-	.358	(50)
FUEL ORIFICE DIAMETER	IN.	DNA	-	-	-	.01870	(50)
OXIDIZER ORIFICE DIAMETER	IN.	DNA	-	-	-	.03800	(50)
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	-	-	-	3.0	(50)
OXIDIZER SAMPLE NUMBER	-	-	-	-	-	238	(50)
FUEL SAMPLE NUMBER	-	-	-	-	-	239	(50)
* N/C AMEND. # 3	SPECIFICATION NUMBER * RA0220-354		DNA		SERIAL NO. 1058232	PART NO. 208160-61	
SE-7 (REA) CALIBRATED PERFORMANCE DATA			PART NAME THRUST CHAMBER, 25 LB., ASSY OF		5.2.1		

R-15019-2

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THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

	LIMITS	ACTUAL COUNT	
		MMH - FUEL	NTD - OXID
		DNA	DNA
< 10	*		
10 - 25	100	63	76
25 - 50	20	7	11
50 - 100	5	5	3
100 - 300	1	1	0
300 - 1000	0	0	0
> 1000	0	0	0
FIBERS 300 - 3000	0	0	0
FIBERS > 3000	0	0	0

* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG).

CLASS 4



SPECIFICATION NUMBER RA0615-003	REVISION B	AMENDMENT # 1	52-52701-265	PART NO.	208160-61
	SE-7 INFORMATION - CONTAMINATION		PART NAME THRUST CHAMBER, 25 LB., ASSY OF		
			5.3		

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SCD 52-52701-265
S/N 4057532

"CERTIFICATION IS HEREBY GIVEN THAT THE DELIVERABLE END ITEM COVERED BY THIS LOG BOOK WAS MANUFACTURED, INSPECTED AND TESTED IN ACCORDANCE WITH PRESCRIBED DRAWINGS, SPECIFICATION AND QUALITY ASSURANCE PROVISIONS. INSPECTION AND TEST RECORDS ARE ON FILE VERIFYING COMPLIANCE WITH APPLICABLE DRAWINGS AND SPECIFICATIONS, EXCEPT AS NOTED HEREIN"

LOG BOOK ACCEPTANCE DAT#9 (DRD #9)

SPACE ENGINES ENGINEERING	SPACE ENGINES QUALITY CONTROL	McDONNELL QUALITY REPRESENTATIVE	GOV'T INSPECTION AGENCY QUALITY REPRESENTATIVE
<i>W. J. McQuarrie O.L.</i> DATE <u>9/11/64</u>	<i>Wm E Ratz</i> DATE <u>9/11/64</u>	<i>C.W. Michael</i> DATE <u>9/14/64</u>	<i>Charles A. Michael</i> DATE <u>11 Sept 64</u>

CONTENTS

SECTION I - DELIVERABLE END ITEM ASSEMBLY LOG

RECORDS CONTAINED IN THIS SECTION ARE PERTINENT TO THE DELIVERABLE END ITEM ACCEPTANCE AND ALSO INCLUDE MODEL CONFIGURATION DATA, PERTINENT DETAILS OF SHORT SHIPMENTS, COMPONENT VARIATIONS, AGE SENSITIVE PARTS RECORD, WEIGHT AND SERIALIZATION RECORDS.

SECTION II - ACCEPTANCE TEST LOG

RECORDS OF ASSEMBLY ACCEPTANCE TESTS ARE PRESENTED IN THIS SECTION WITH PERFORMANCE DATA AND SUMMARY DATA ON INSPECTIONS AND ACCEPTANCE.

GENERAL INFORMATION

THIS LOG BOOK IS PROVIDED FOR SERVICE USE IN RECORDING PERTINENT HISTORICAL DATA AND ALL CHANGES FROM THE ORIGINAL CONFIGURATION. IT IS REQUESTED THIS LOG BOOK ACCOMPANY THE DELIVERABLE END ITEM WHEN TRANSFERRED BETWEEN ROCKEIDYNE AND USING AGENCIES.

GROUP-4

Downgraded at 3 year intervals
declassified after 12 years

ROCKEIDYNE - SPACE ENGINES

A DIVISION OF NORTH AMERICAN AVIATION, INC.

LOG BOOK SPECIFICS

McDONNELL	ITEM	ROCKEIDYNE
THIS MATERIAL CONTAINS INFORMATION AFFECTING THE NATIONAL DEFENSE OF THE UNITED STATES WITHIN THE MEANING OF THE ESPIONAGE LAWS, TITLE 18 U.S.C. SECTION 793 AND 794. ITS TRANSMISSION OR THE REVELATION OF ITS CONTENTS IN ANY MANNER TO AN UNAUTHORIZED PERSON IS PROHIBITED BY LAW.		
	LOG BOOK DATE	11 SEPT 64
	DWG CHG LTR	DNA
	CONTRACT NO.	
	GEN ORDER NO.	5252
	SPEC NO.	
	SERIAL NO.	4057532
	PART NO.	208160 -61

SE 7 DELIVERABLE END ITEM - LOG BOOK IDENTIFICATION

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

1.0

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DELIVERABLE END ITEM

THIS LOG BOOK CONTAINS INFORMATION PERTINENT TO THE DELIVERABLE END ITEM AS SPECIFIED HEREIN BY SERIAL NUMBER AND PART NUMBER. IT IS NECESSARY THAT ALL ENTRIES BE WRITTEN IN INK OR TYPED FOR PERMANENT RECORD. ENTRIES SUCH AS SERIALIZATION, WEIGHT, APPLICABLE MCR'S, ACCEPTANCE TEST DATA AND CALIBRATION DATA WILL BE ENTERED BY ROCKETDYNE AT THE TIME OF DELIVERY.

IT IS REQUESTED THAT THIS LOG BOOK ACCOMPANY THIS DELIVERABLE END ITEM IF THE ITEM IS RETURNED TO ROCKETDYNE FOR REPAIR, MODIFICATION OR RETEST. ROCKETDYNE WILL THEN ENTER REPAIR, MODIFICATION AND RETEST DATA IN THIS LOG BOOK.

THE FORMAT OF PAGES IN THIS LOG BOOK SHALL NOT BE REVISED WITHOUT OBTAINING APPROVAL OF ROCKETDYNE SPACE ENGINES QUALITY CONTROL.

52-52701-265 PART NO. 208160 -61

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 2.0

1.0 LOG BOOK IDENTIFICATION

2.0 FOREWORD

3.0 CONTENTS

4.0 MODULE/COMPONENT ASSEMBLY LOG--SECTION I

4.1 CONFIGURATION & SERIALIZATION LOG

4.2 MCR VERIFICATION

4.3 VARIATION LOG

4.4 REPLACEMENT LOG

5.0 COMPONENT ACCEPTANCE TEST LOG--SECTION II

5.1 COMPONENT ACCEPTANCE TEST

5.1.1 COMPONENT ACCEPTANCE TEST

5.1.2 COMPONENT ACCEPTANCE TEST

5.1.3 COMPONENT ACCEPTANCE TEST

5.1.4 COMPONENT ACCEPTANCE TEST

5.1.5 COMPONENT ACCEPTANCE TEST

5.2 CALIBRATED PERFORMANCE DATA

5.2.1 CALIBRATED PERFORMANCE DATA

5.2.2 CALIBRATED PERFORMANCE DATA

5.3 INFORMATION--CONTAMINATION

52-52701-265

PART NO. 208160-61

CONTENTS--SE-7 LOG BOOK

PART NAME THRUST CHAMBER, 25 LB., ASSY OF

3.0

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SECTION I

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R-17010-2


52-52701-265 PART NO. 203160-61

PART NAME THRUST CHAMBER, 25 LB., ASSY OF 4.0

SE-7 MODULE / COMPONENT ASSEMBLY LOG

IND. NO.	PART NUMBER	REV. LTR.	PART NAME	SERIAL NO.	AGE CONTROL DATE OF MFG.	INSP.
1	203160-61	DNA	THRUST CHAMBER, 25 LB., ASSY OF	4057532	2Q64	(NH 206)
2	203161-11	DNA	BODY, THRUST CHAMBER, ASSY OF	4060471	2Q64	(NH 206)
2	203163	DNA	SHELL, THRUST CHAMBER, ASSY OF	8503029		(NH 206)
3	203530-11	DNA	INJECTOR, THRUST CHAMBER, ASSY OF	7060491		(NH 206)
2	407559	DNA	VALVE, OXIDIZER, T/C, ASSY OF	4057735		(NH 206)
2	407560	DNA	VALVE, FUEL, T/C, ASSY OF	4055173		(NH 206)
<div> <div>DNA</div> <div>SERIAL NO. 4057532</div> </div> <div> <div>52-52701-265</div> <div>PART NO. 203160-61</div> </div>						
<div> <div>SE- 7 CONFIGURATION & SERIALIZATION LOG</div> <div>PART NAME THRUST CHAMBER, 25 LB., ASSY OF</div> <div>4.1</div> </div>						

MR NO.	PART OR COMP. INVOLVED	PART NUMBER	SERIAL NUMBER	BRIEF DESCRIPTION OF VARIATION AND MATERIAL REVIEW BOARD DISPOSITION	INSP.
600N5 #C16835	25 LB. THRUST CHAMBER ASSY.	208160-61	4057532	<p>DISCREPANCY: THERE ARE VARIOUS NICKS AND SCRATCHES ON THE SHELL ASSEMBLY, THE MOST OUTSTANDING ONE IS LOCATED UNDER THE NUT PLATE AT 12:00 USING THE WELD LINE FROM INJECTOR TO FLANGE AS A REFERENCE. DRILL MARK IS .011 DEEP AND .025 x .030 OVERALL.</p> <p>DISPOSITION: USE AS IS.</p>	<div style="border: 1px solid black; border-radius: 50%; width: 30px; height: 30px; display: flex; align-items: center; justify-content: center;"> <div style="writing-mode: vertical-rl; transform: rotate(180deg);">INSP.</div> <div style="text-align: center;">208</div> </div>
				DNA SERIAL NO. 4057532 52-52701-265 PART NO. 208160-61	
SE-7 DELIVERABLE END ITEM - VARIATION LOG				PART NAME THRUST CHAMBER, 25 LB., ASSY OF	4.3

PART NO.	PART NAME	SERIAL NO.	REASON FOR REPLACEMENT	REPLACED BY		INSP.
				PART NO.	SERIAL NO.	
			NONE THIS DATE - (11 SEPT 64)			
			DNA	SERIAL NO.	4057532	
			52-52701-265	PART NO.	208160-61	
SE-7 DELIVERABLE END ITEM--REPLACEMENT LOG			PART NAME	THRUST CHAMBER, 25 LB., ASSY OF 4.4		

SECTION II

52-52701-265

PART NO.

208160-61

SE - 7 COMPONENT ACCEPTANCE TEST LOG

PART NAME

THRUST CHAMBER, 25 LB., ASSY QZ

5.0

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>ELECTRICAL RESISTANCE TESTS--TCA PROPELLANT VALVES</u>					
BODY TEMPERATURE	4.2				
OXIDIZER	4.2.4	DEGREES F	70 ± 5	69	NR 205
FUEL	4.2.11	DEGREES F	70 ± 5	69	NR 208
COIL RESISTANCE					
OXIDIZER	4.2.5	OHMS	42 ± 2	41.08	NR 205
FUEL	4.2.11	OHMS	42 ± 2	41.01	NR 208
CONTINUITY RESISTANCE					
OXIDIZER	4.2.9	OHMS	1.0 MAX.	.08	NR 205
FUEL	4.2.11	OHMS	1.0 MAX.	.06	NR 208
	4.3				
<u>DIELECTRIC STRENGTH TEST--PROPELLANT VALVES</u>					
CURRENT LEAKAGE					
OXIDIZER	4.3.8	MICROAMPS	500 MAX.	34	NR 205
FUEL	4.3.11	MICROAMPS	500 MAX.	31	NR 208
	4.4				
<u>PROOF PRESSURE TEST--TCA PROPELLANT VALVES</u>					
VALVES PRESSURIZED FOR NOT LESS THAN 3 MINUTES					
OXIDIZER	4.4.3	PSIG	500 ± 10	VERIFIED	NR 205
STEP I					
STEP II	4.4.5	PSIG	500 ± 10	VERIFIED	NR 208
<div> <div> SPECIFICATION NUMBER RA0220-354 </div> <div> REVISION NC </div> <div> AMENDMENT #3 </div> </div> <div> DNA 52-52701-265 </div> <div> SERIAL NO. 4057532 </div> <div> PART NO. 208160-61 </div>					
SE-7 COMPONENT ACCEPTANCE TEST					5.1
PART NAME THRUST CHAMBER, 25 LB., ASSY OF					

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
PROOF PRESSURE TEST--TCA PROPELLANT VALVES (CONTINUED)					
FUEL					
STEP I	4.4.7	PSIG	500 ± 10	VERIFIED	ANR 208
STEP II	4.4.7	PSIG	500 ± 10	VERIFIED	ANR 208
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION					
OXIDIZER					
STEP I	4.4.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
STEP II	4.4.5	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
FUEL					
STEP I	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
STEP II	4.4.7	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER	4.5				
PROOF PRESSURE TEST					
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES AT					
STEP I	4.5.8	PSIG	392 ± 10	VERIFIED	ANR 208
STEP II	4.5.10	PSIG	392 ± 10	VERIFIED	ANR 208
<div style="display: flex; justify-content: space-between;"> <div> SPECIFICATION NUMBER RAC220-354 </div> <div> REVISION N2 </div> <div> AMENDMENT #3 </div> </div>					
<div style="display: flex; justify-content: space-between;"> <div> DNA </div> <div> SERIAL NO. 4057532 </div> </div>					
<div style="display: flex; justify-content: space-between;"> <div> 52-52701-265 </div> <div> PART NO. 208160-51 </div> </div>					
<div style="display: flex; justify-content: space-between;"> <div> SE - 7 COMPONENT ACCEPTANCE TEST </div> <div> PART NAME THRUST CHAMBER, 25 LB., ASSY OF </div> <div> 5.1.1 </div> </div>					

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>PROOF PRESSURE AND LEAKAGE TEST--THRUST CHAMBER</u> (CONTINUED)					
<u>LEAKAGE TEST</u>	STEP I	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
	STEP II	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
	INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	DNA	NONE ALLOWED	NONE DETECTED	ANR 208
<u>FUNCTIONAL TEST--TCA PROPELLANT VALVES</u>					
OPENING RESPONSE TIME	4.5.8	SEC.	0.0065 MAX.	.0034	ANR 208
	4.5.10	SEC.	0.0065 MAX.	.0031	ANR 208
CLOSING RESPONSE TIME	4.6.17	SEC.	0.002 MAX.	.0012	ANR 208
	4.6.10	SEC.	0.002 MAX.	.0014	ANR 208
CLOSING DROP OUT VOLTAGE	4.6.17	VOLT (DC)	1 MIN.	1.5	ANR 208
	4.6.13	VOLT (DC)	1 MIN.	1.1	ANR 208
SPECIFICATION NUMBER RAC20-354 REVISION NC AMENDMENT #3 SERIAL NO. 4057532 PART NO. 208160-61					
SE-7 COMPONENT ACCEPTANCE TEST				PART NAME THRUST CHAMBER, 25 LB., ASSY OF	5.1.2

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
<u>LEAKAGE TEST--TCA PROPELLANT VALVES</u>	4.8				
SEAT LEAKAGE RATE					
OXIDIZER	4.8.17	SCG/MIN	2.21 MAX.	LESS THAN 0.1	ANR 209
FUEL	4.8.22	SCG/MIN	2.21 MAX.	LESS THAN 0.1	ANR 209
<u>PRE-TEST DATA</u>					
DRY WEIGHT (EXCLUDING PROTECTIVE CLOSURES)	4.1.1.3	LB.	DNA	3.20	ANR 209
NOZZLE EXIT DIAMETER					
SECTION A-A		INCH	DNA	2.243	ANR 209
THROAT DIAMETER					
SECTION A-A		INCH	DNA	.358	ANR 209
B-B		INCH	DNA	.358	ANR 209
C-C		INCH	DNA	.358	ANR 209
D-D		INCH	DNA	.358	ANR 209
<u>POST HOT-FIRE DATA</u>					
<u>PROOF PRESSURE TEST</u>					
DRY WEIGHT (EXCLUDING PROTECTIVE COVERS & CLOSURES)	4.17.1	LB.	DNA	3.22	ANR 209
THRUST CHAMBER PRESSURIZED FOR NOT LESS THAN 5 MINUTES					
STEP I	4.17.4	PSIG	392 ± 10	392	ANR 209
STEP II	4.17.4	PSIG	392 ± 10	390	ANR 209
SPECIFICATION NUMBER RAO220-354	REVISION N/C	AMENDMENT #3		DNA	4057532
SE-7 COMPONENT ACCEPTANCE TEST		PART NAME	THRUST CHAMBER, 25 LB., ASSY OF	52-52701-265	208160-61
				5.1.3	

PERFORMANCE PARAMETERS	PARAGRAPH NUMBER	UNITS	SPECIFICATION LIMITS	ACCEPTANCE TEST DATA	INSP.
134 POST HOT-FIRE DATA (CONTINUED)					
LEAKAGE TEST					
STEP I	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 203
STEP II	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 203
INSPECTED VISUALLY FOR DAMAGE OR DEFORMATION	4.17.4	DNA	NONE ALLOWED	NONE DETECTED	ANR 203
LEAK TEST -- WELDED JOINTS					
LEAK TEST					
INLET TUBE PRESSURIZED WITH GASEOUS HELIUM					
OXIDIZER	4.17.5	PSIG	500 ± 10	VERIFIED	ANR 203
FUEL	4.17.8	PSIG	500 ± 10	VERIFIED	ANR 203
JOINT LEAKAGE RATE					
OXIDIZER	4.17.6	SCC/SEC	10 ⁻⁶ MAX.	3.8X10 ⁻⁸	ANR 203
FUEL	4.17.8	SCC/SEC	10 ⁻⁶ MAX.	1.1X10 ⁻⁷	ANR 203
LEAKAGE TEST -- TCA PROPELLANT VALVES					
SEAT LEAKAGE RATE					
OXIDIZER	4.17.9	SCC/SEC	2.21 MAX.	LESS THAN 0.1	ANR 203
FUEL	4.17.9	SCC/SEC	2.21 MAX.	LESS THAN 0.1	ANR 203
SPECIFICATION NUMBER	AMENDMENT	REVISION	REVISED	SERIAL NO.	4057532
RA0220-354	#3	NO		PART NO.	208160-61
SE-7 COMPONENT ACCEPTANCE TEST				PART NAME	THRUST CHAMBER, 25 LB., ASSY OF
					5.1.1

R-15019-2

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 193 TEST DATA	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN 196 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	NFL	-	-	NFL	(AIR 95)
CELL LOCATION	-	-	1-C	-	-	1-C	(AIR 95)
CELL NUMBER	-	-	379	-	-	379	(AIR 95)
TEST DATE	-	-	11 Aug 1964	-	-	13 Aug 1964	(AIR 95)
TEST DURATION	SEC.	2 MIN.	3.0	-	-	3.0	(AIR 95)
ENVIRONMENTAL PC	PSIA	.16 MAX.	.05020	-	-	.07240	(AIR 95)
AMBIENT PRESSURE	PSIA	DNA	12.23	-	-	12.16	(AIR 95)
AMBIENT TEMPERATURE	°F	DNA	84.0	-	-	80.0	(AIR 95)
TIME OF DATA SLICE-START	SEC.	DNA	2.8	-	-	2.8	(AIR 95)
TIME OF DATA SLICE-END	SEC.	DNA	2.8	-	-	2.8	(AIR 95)
OXIDIZER TEMPERATURE	°F	DNA	77.6	-	-	65.5	(AIR 95)
FUEL TEMPERATURE	°F	DNA	77.5	-	-	67.0	(AIR 95)
OXIDIZER DENSITY	LB/FT ³	DNA	90.87	-	-	91.20	(AIR 95)
FUEL DENSITY	LB/FT ³	DNA	54.37	-	-	54.85	(AIR 95)
REV. NONE	AMEND. #3	SPECIFICATION NUMBER BA0220-354	DNA	SERIAL NO.	4057532		
			52-52701-265	PART NO.	208160-61		
SE-7 (REA) CALIBRATED PERFORMANCE DATA		PART NAME	THRUST CHAMBER, 25 LB., ASSY OF				5.2

SERIAL CONTAINS INFORMATION AFFECTING
THE NATIONAL DEFENSE OF THE U S D STATES
WITHIN THE MEANING OF THE ESPIONAGE LAWS,
TITLE 18 U.S.C., SECTIONS 793 AND 794. ITS DISCLOSURE
IN MISSION OR THE REVELATION OF ITS CONTENTS IN
ANY MANNER TO AN UNAUTHORIZED PERSON IS
PROHIBITED BY LAW

~~CONFIDENTIAL~~

GROUP 4

Downgraded at 3 year intervals:
declassified after 12 years

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	RUN 193 TEST DATA	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN 196 FINAL TEST DATA	INSP.
HOT FIRE TEST DATA - TEST SITE	-	-	NFL	-	-	NFL	
OXIDIZER INLET PRESSURE	PSIA	292 ± 10	294.0	-	-	291.9	(AIR 60)
FUEL INLET PRESSURE	PSIA	292 ± 10	287.7	-	-	291.5	(AIR 60)
OXIDIZER FLOWRATE	LB/SEC.	DNA	.04747	-	-	.04473	(AIR 60)
FUEL FLOWRATE	LB/SEC.	DNA	.03396	-	-	.03423	(AIR 60)
THRUST	LB.	DNA	23.4	-	-	22.6	(AIR 60)
MIXTURE RATIO	O/F	DNA	1.40	-	-	1.31	(AIR 60)
SPECIFIC IMPULSE	SEC.	DNA	288.	-	-	287.	(AIR 60)
INJECTOR END PS	PSIA	DNA	136.3	-	-	131.9	(AIR 60)
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	5423.	-	-	5410.	(AIR 60)
THROAT DIAMETER	IN.	DNA	.358	-	-	.358	(AIR 60)
FUEL ORIFICE DIAMETER	IN.	DNA	.04958	-	-	.04820	(AIR 60)
OXIDIZER ORIFICE DIAMETER	IN.	DNA	.03987	-	-	.03785	(AIR 60)
TCA FIRING TIME (TOTAL)	SEC.	10 MAX.	3.0	-	-	6.0	(AIR 60)
OXIDIZER SAMPLE NUMBER	-	-	278.	-	-	281.	(AIR 60)
FUEL SAMPLE NUMBER	-	-	279.	-	-	279.	(AIR 60)

REV. NONE	AMEND. #3	SPECIFICATION NUMBER	DNA	SERIAL NO.	4057532
		RA0220-354	52-52701-265	PART NO.	208160-61

SE-7 (REA) CALIBRATED PERFORMANCE DATA

THRUST CHAMBER, 25 LB., ASSY OF

5.2.1

~~CONFIDENTIAL~~

THIS MATERIAL CONTAINS INFORMATION AFFECTING
NATIONAL DEFENSE OF THE UNITED STATES
WITHIN THE MEANING OF THE ESPIONAGE LAWS.

GROUP 4

Downgraded at 3 year intervals:
declassified after 12 years

TITLE 18 U.S.C., SECTIONS 793 AND 794, ITS TRANS-
MISSION OR THE REVELATION OF ITS CONTENTS IN
ANY MANNER TO AN UNAUTHORIZED PERSON IS
PROHIBITED BY LAW.

CHARACTERISTICS	UNITS	SPECIFICATION LIMITS	PERFORMANCE DATA - 17 YEARS			
			RUN 193 TEST DATA	RUN ***** TEST DATA	RUN ***** TEST DATA	RUN 196 FINAL TEST DATA
HOT FIRE TEST DATA - TEST SITE	-	-	NFL	-	-	NFL
ADJUST TO STANDARD CONDITIONS						
THRUST	LB.	23 ± 1.2	23.6	-	-	22.8 ANR 095
MIXTURE RATIO	O/F	1.30 ± .04	1.36	-	-	1.30 ANR 095
SPECIFIC IMPULSE	SEC.	DNA	290.	-	-	290. ANR 095
INJECTOR END Pc	PSIA	DNA	136.2	-	-	131.5 ANR 095
CHARACTERISTIC VELOCITY	FT/SEC.	DNA	5416.	-	-	5407. ANR 095
ADJUST TO RATED CONDITIONS						
THRUST	LB.	23	23.0	-	-	23.0 ANR 095
MIXTURE RATIO	O/F	1.3	1.30	-	-	1.30 ANR 095
SPECIFIC IMPULSE	SEC.	272 MIN.	289.	-	-	290. ANR 095
* REV. NONE AMEND.#3		#SPECIFICATION**NUMBER	DNA		SERIAL NO.	4057532
** REV. NONE AMEND.#2		RA0220-354 and RA0220-230			PART NO.	208160-61
SE- 7 (REA) CALIBRATED PERFORMANCE DATA + <small>+ based at 3 year intervals</small>			PART NAME THRUST CHAMBER, 25 LB., ASSY OF 5.2.2			

Case-7 (REA) CALIBRATED PERFORMANCE DATA -
 1 2 3 4 5 6 7 8 9 10 11 12
 12 classified after 12 years

Classified after 12 years

THE FOLLOWING IS INFORMATION RELATIVE TO THE CLEANLINESS LEVEL OF THE PROPELLANT UTILIZED IN THE HOT-FIRE ACCEPTANCE TEST OF THE THRUST CHAMBER ASSEMBLY.

THE INFLUENT PARTICULATE COUNT OF THE PROPELLANT WAS:

	LIMITS	ACTUAL COUNT		ACTUAL COUNT	
		MMH - FUEL	NTD - OXID	MMH - FUEL	NTD - OXID
< 10	*	DMA	DMA	DMA	DMA
10 - 25	100	55	15	55	15
25 - 50	20	9	1	9	1
50 - 100	5	1	0	1	0
100 - 300	1	0	1	0	1
300 - 1000	0	0	0	0	0
> 1000	0	0	0	0	0
FIBERS 300 - 3000	0	0	0	0	0
FIBERS > 3000	0	0	0	0	0

* NOTE: " NOT TO BE COUNTED BUT NO SLURRY OF FINE PARTICLES WHICH COVERS MORE THAN AN ESTIMATED 5 PERCENT OF THE TOTAL EFFECTIVE FILTER AREA SHALL BE ALLOWED." AT THE DISCRETION OF QUALITY ASSURANCE, A WEIGHT DETERMINATION OF TOTAL CONTAMINATION MAY BE MADE AS A REFEREE TEST IN BORDERLINE CASES. THE MAXIMUM ALLOWABLE WEIGHT OF CONTAMINANTS SHALL BE 0.001 GRAM (1 MG).

CLASS 4

INSP. 

SPECIFICATION NUMBER	REVISION	AMENDMENT
RAC615-003	B	#2
SE-7 INFORMATION - CONTAMINATION		

52-5270-265 PART NO. 208160-61

PART NAME THRUST CHAMBER 25 LB., ASSY OF

5.3



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APPENDIX D

DESIGN APPROVAL TEST SPECIFICATION
AND DATA



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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANUEVER SYSTEM
(SE-7)

THRUST CHAMBER ASSEMBLY - 25#

McDonnell Part Number - 52-52701-265
Rocketdyne Part Number- 208160-61
Test Number - 208160-401

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.
6633 CANOGA AVENUE
CANOGA PARK, CALIFORNIA

PREPARED BY

E. Adams

APPROVED BY

[Signature]

R. W. Helsel
Sr. Proj. Engr.
Gemini

NO. OF PAGES 380

REVISIONS

DATE 3 August 1964

DATE	REV. BY	PAGES AFFECTED	REMARKS
21 Aug 64	PA	50, 376	Deleted Injector Plate Accelerometer
21 Aug 64	RC	30	Changed Figure 12
29 Sept 64	JG	36 & 37	Revised Procedure of para 6.7
29 Sept 64	JG	379	Revised Figure 10
21 Oct 64	RC	39, 40 & 41	Revised Procedure of para 6.8
21 Oct 64	RC	40.1	Added page
15 Oct 64	EA	13.1	Added page
28 Oct 64	JG	358, 359	Revised Table I

(PRELIMINARY) (FINAL) APPROVAL
This drawing is hereby approved (with) (without) changes. Such approval does not relieve Seller warranty as provided in M. A. C. purchase order conditions.

EFF: DAT CONT. DWG: 52-52701-265
J. D. Harrop 15 Aug 64
J. D. Harrop 23 Nov 64

J. D. Harrop 1-5-65
James D. Harrop 1-28-65

for pp 1-70, 91-102, 332-335
& 368-380 only

also approved PP 71-90, 358-362

also approved PP 356-358, 352-355
J.D.H. 10/29/64

also approved PP 15, 41.2, 41-3,
89.01-89.24, 380.1, 380.2,
380.3 J.D. Harrop 11/3/64

also approved
PP 103, 104, 111;
PP 105, 106, 107
PP 313, 314, 315

DESIGN APPROVAL TESTS OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANUEVER SYSTEM
(SE7)

THRUST CHAMBER ASSEMBLY -25#

McDonnell Part Number - 52-52701-265
Rocketdyne Part Number- 208160-61
Test Number - 208160-401

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

DATE	REV. BY	PAGES AFFECTED	REMARKS
11 Sep 64	RC	55	Changed X to Z
6 Oct 64	EA	334	Changed paragraph number
28 Oct 64	JG	373	Revised Figure 6
20 Nov 64	FA	380	Revised Figure 11
1 Dec 64	RC	330	Revised procedure of Para. 7.2.5
1 Dec 64	RC	330.1 & 331.1	Added pages
1 Dec 64	RC	356	Revised para. 7.3.4
1 Dec 64	RC	356.1 & 357.1	Added Pages
1 Dec 64	JG	359.1	Added Page
3 Dec 64	RC	41.1, 41.2 &	Changed Page Nos.
3 Dec 64	RC	15	Added Ex. Atmos & Fuel Test Ox. Resist. Test
3 Dec 64	RC	89.01, 89.02, 89.03, 89.04, 89.05, 89.06, 89.07, 89.08, 89.09, 89.1, 89.11, 89.12, 89.13, 89.14, 89.15, 89.16, 89.17, 89.18, 89.19, 89.2, 89.21, 89.22, 89.23 & 89.24	Added Page Numbers
3 Dec 64	RC	380.1, 380.2 & 380.3	Added Figures 12, 13 & 14
22 Dec 64	RC	111	Added Data Sheet
22 Dec	RC	89.25, 89.26, 89.27, 89.28, 89.29, 89.30, 89.31, 89.32, 89.33, 89.34, 89.35, 89.36, 89.37, 89.38, 89.39, 89.40, 89.41, 89.42, 89.43, 89.44, 89.45, 89.46, 89.47, 89.48, 89.49, 89.50, 89.51, 89.52, 89.53, 89.54, 89.55, 89.56, 89.57, 89.58, 89.59, 89.60, 89.61, 89.62, 89.63, 89.64, 89.65, 89.66, 89.67, 89.68, 89.69, 89.70, 89.71, 89.72, 89.73, 89.74, 89.75, 89.76, 89.77, 89.78, 89.79, 89.80, 89.81, 89.82, 89.83, 89.84, 89.85, 89.86, 89.87, 89.88, 89.89, 89.90, 89.91, 89.92, 89.93, 89.94, 89.95, 89.96, 89.97, 89.98, 89.99, 89.100	

FORM R 15-0-4

THRUST CHAMBER ASSEMBLY - 25#

McDonnell Part Number 52-52701-265

Rocketdyne Part Number 208160-61

Test Number 208160-401

DESCRIPTION OF COMPONENT

The OAMS Thrust Chamber Assembly consists of an ablation cooled thrust chamber with a silicon carbide throat insert and expansion nozzle, an injector, two fast acting solenoid valves for propellant flow control, orifices for fixing the component pressure drop, associated interconnecting plumbing and mounting provisions for attaching the assembly to the spacecraft structure.

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. 208160 SHEET 1 OF 380

Reference: MAC SCD 52-52701- Rev. F

1.0

SCOPE

This specification establishes the method of test and the test equipment required to conduct the Design Approval Tests of Three Thrust Chamber Assemblies for the McDonnell Aircraft Corporation Model 133P, Orbit Attitude and Maneuver System as specified in McDonnell Aircraft Corporation Specification Control Drawing 52-52701, Rev. F, paragraph 6.3.1.3.2.

PREPARED BY: <i>Et</i> E. Adams	DATE 4/10/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 4-13-64	APPROVED FOR McDONNELL <i>[Crossed out]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 4-10-64				

FORM 608-B-40 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. 208160-401 SHEET 2 OF 380

Reference: (a) MAC SCD 52-52701, Revision F

2.0 APPLICABLE DOCUMENTS

The documents listed in this specification are for reference only except those marked with an asterisk (*). If the requirements of this specification differ from those listed below, the requirements of this specification shall govern, except in the case of SCD 52-52701 which is the contractual controlling document.

2.1 McDonnell Aircraft Specifications

SCD 52-52701 Specification Control Drawing, MAC Model 133P, Orbit Attitude and Maneuver System Rev. F, dated 9 August 1963. (CONFIDENTIAL)

*Report #8392 Standard Engineering Responsibilities Technical Data Requirements and Product Support Recommendations, Model 133P SCD Equipment, dated 22 June 1962.

Report #8518 General Electrical Design Requirements for Electrical Equipment and Equipment Utilizing Electrical Power for MAC Model 133P, dated 1 May 1962.

2.2 Military Specifications

MIL-E-5272C-1 Environmental Testing, Aero and Associated Equipment, General Specification for, dated 20 January 1960.

PREPARED BY: <u>E. Adams</u> <i>Ed</i> DATE <u>4/10/64</u>	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL DATE
CHECKED BY: <u>4/7/64</u> <i>W. Adams</i> DATE <u>4/14/64</u>	<i>R. Eide</i> 4-13-64	

FORM 608-B-40 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. 208160-401 SHEET 3 OF 30

2.2
(cont'd)

MIL-L-25567

Leak Test Compound, Oxygen System,
dated 7 January 1959

MIL-P-26539A

Propellant, Nitrogen Tetroxide,
dated 31 July 1961

MIL-P-27401A

Propellant, Nitrogen Pressurizing,
dated 7 November 1960

MIL-P-27404

Propellant, Monomethyl Hydrazine,
dated 3 April 1962

MIL-A-6091B

Alcohol; Ethyl, Specially denatured,
dated 12 January 1962

Federal Stock No.
6830-263-9842

Helium

2.3

Rocketdyne Specifications

*RA0112-002

Lubricants, Anti-Seize Compounds and
Gasketing Type Seal Compounds for Rocket
Engines, dated 29 July 1963

*RAO 220-290

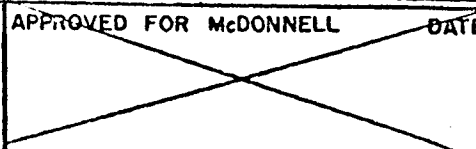
SE6 and SE7 Propulsion System Component
Weight Determination, dated 2 October
1963

RAO 220-230

SE7 208160 Assembly Data Reduction and
Adjustments, dated 15 July 1963
(CONFIDENTIAL)

*RAO 220-354

Gemini SE7 Thrust Chamber Assembly
Acceptance Test Procedure, dated 6
January 1964

PREPARED BY: E. Adams	DATE 5/28/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>F. J. ...</i>	DATE 1-3-64	<i>R. H. ... 8-4-64</i>			

FORM 608-B-40 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 203160-61
TEST NO. 208160-401 SHEET 4 OF 380

- | | | |
|-----------------|----------------|---|
| 2.3
(cont'd) | *RA0201-050 | Acceptance Test Instrumentation Requirements, dated 9 August 1961 |
| | *RA0607-009 | In Place Brazing of Tubes and Fittings for Space Engines, dated 30 December 1963 |
| | *RA0610-002 | Ultrasonic Cleaning of Space Engine Hardware, dated 20 June 1963 |
| | *RA0610-003 | Cleaning Space Engine Hardware by Liquid Flushing, dated 24 October 1963 |
| | *RA0610-009 | Chemical Cleaning of Filter Elements for Space Engines, dated 22 April 1964 |
| | *PEM 25.01G | Environmentally Controlled Areas, Definitions and Specifications for, dated 2 December 1963 |
| | *RA0616-005 | SE7 Propulsion System Inter and Intra Plant Handling, dated 20 March 1963 |
| | *SEM 4388-4040 | Pulse Performance Data Reduction Procedure dated 22 July 1964 |
| | * RA0616- 008 | SE7 Propulsion System: Preparation for Customer Delivery, dated 4 September 1963 |
| | SEM 3391-3009 | Operation Manual SE6 and SE7 Electrical Control System, dated 28 August 1963. |

PREPARED BY: E. Adams	DATE 7-20-64	APPROVED FOR NAA: <i>Ray Eide</i>	DATE 8-4-64	APPROVED FOR McDONNELL <i>[Signature]</i>	DATE <i>[Signature]</i>
CHECKED BY: <i>[Signature]</i>	DATE 8-3-64				

FORM 608-B-40 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. 208160-401 SHEET 5 OF 380

2.4

Rocketdyne Drawings

Drawing 208160 (-61) Thrust Chamber, 25 lbs, 45 Min, Assy of,
dated 26 September 1963

Drawing T5034515 Pressure Test and Water Flow Fixture,
dated 19 July 1963

Drawing 99-106126 Adapter - Fitting, Assy of, dated
22 October 1963

Drawing 99-106713 Thrust Chamber Installation - 25# OAMS,
dated 17 April 1964

Drawing 99-106694 Tube Assy of, dated 10 April 1964

Drawing 99-106695 Tube, Assy of, dated 10 April 1964

Drawing Shipping Container, SE7 25# TCA with
Extended Inlet Adapters, dated

Drawing 99-106728 Propellant Valve Orifice Adapter, dated
23 September 1964

PREPARED BY: E. Adams	DATE 7-20-64	APPROVED FOR NAA: <i>RA Eide</i>	DATE 8-4-64	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>W. J. Jensen</i>	DATE 8-3-64				

FORM 608-B-40 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. 208160-401 SHEET 6 OF 380

Reference: (a) MAC SCD 52-52701, Revision F

3.0 GENERAL REQUIREMENTS

3.1 Safety

All safety precautions necessary to comply with this procedure shall be in accordance with Rocketdyne Safety Department Directives.

3.2 Handling

All inter and intra plant handling and packaging shall be accomplished per the requirements of Rocketdyne Specification RA0616-005 when the TCA is being transported, or stored between tests, except that Components with extended inlet tube stubs installed shall be packaged in container.

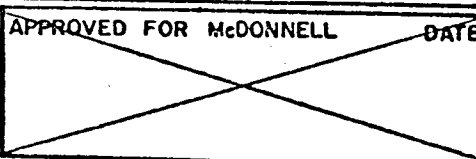
3.3 Photographic Coverage

Photographs shall be taken of each different TCA installation test and shall be included in the final test report. Three preliminary copies of these pictures shall be forwarded to the Rocketdyne Gemini Project Office within 14 days from the exposure date.

Photographs which will provide visual evidence of a failure shall be taken of the component after any malfunction. Sufficient views shall be taken to provide complete visual coverage of the failure, including photomicrographs when applicable.

3.4 Instrumentation (paragraph 6.2.1.2 of reference a)

All test parameters shall be assigned a tolerance of $\pm 2\%$ of the specified value unless otherwise denoted herein.

PREPARED BY: E. Adams	DATE 5/28/64	APPROVED FOR NAA:	DATE 8-4-64	APPROVED FOR McDONNELL	DATE
CHECKED BY: J. L. Smith	DATE 8-3-64				

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**DESIGN APPROVAL TEST OF COMPONENTS
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3.4
(cont'd)

All instrumentation employed for monitoring the required test parameters shall be calibrated at frequent intervals to insure attainment of minimum steady-state accuracy of $\pm 2\%$ of the full scale range of the instrumentation being used, except where instrumentation accuracy is otherwise specified. Calibration records shall be maintained and made available to authorized personnel upon request. Hot fire instrumentation shall be in accordance with specification RA0201-050 and Table I of this specification.

3.5

Maintenance (paragraph 6.2.3 of reference a)

Servicing, adjustment, or replacement of parts shall not be permitted unless specifically stated in this specification. Lubrication of fittings is permitted per RA0112-002.

3.6

Failures (paragraph 2.5.2 of McDonnell report 8392)

In the event that the component fails to pass any part of the Design Approval Test, immediately discontinue all testing of that component and notify the Rocketdyne Gemini Project Office.

McDonnell Aircraft Corporation and Rocketdyne shall jointly review the failure and determine the corrective action to be taken and the point in the test procedure where retesting is to begin.

3.7

Test Witnessing (paragraph 6.2.1.3 of reference a)

Each Design Approval Test shall be witnessed and the test data certified by Rocketdyne inspection, and certified by the Government Inspection Agency having cognizance at the testing facility. McDonnell and Government Inspectors shall be notified 4 hours in advance of all tests.

PREPARED BY: <u>E. Adams</u> <u>8-4-64</u>	DATE	APPROVED FOR NAA: <u>[Signature]</u> <u>8-4-64</u>	DATE	APPROVED FOR McDONNELL	DATE
CHECKED BY: <u>[Signature]</u> <u>8-3-64</u>	DATE				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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3.7
(continued)


MAC Engineering shall be notified 3 days in advance of the schedule date of any Design Approval Test. If MAC Engineering indicates a desire to witness any test, notification shall again be performed 4 hours prior to the beginning of the test. Actual testing shall not commence prior to the arrival of all witnesses unless prior waiver is obtained. Notification of the MAC Resident Engineering Office shall constitute notification of MAC Engineering.

3.8

Cleanliness Requirements

Hot Fire Test and Decontamination Facilities: During the time that the TCA is being installed in or removed from a hot fire test facility or a decontamination facility, the TCA propellant valve inlets, when open, shall be protected by a plastic enclosure. A low volume nitrogen purge, filtered through two, 10 micron absolute, stainless steel wire mesh filters, installed in series, shall be used to prevent entrance of foreign material into the enclosure.

Other Test Facilities: The propellant valve inlets shall not be directly exposed to an environmental atmosphere which does not meet the requirements of a Class IV area as specified in Rocketdyne Plant Engineering Manual PEM 25.01G. It shall be requirement that a ten (10) micron absolute wire mesh stainless steel filter be installed on the propellant valve inlets in a Class IV area. The entire test setup shall be assembled and disassembled in a Class IV area.

PREPARED BY: E. Adams	DATE 1-20-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
CHECKED BY: R. J. Jones	DATE 8-3-64	8-4-64			
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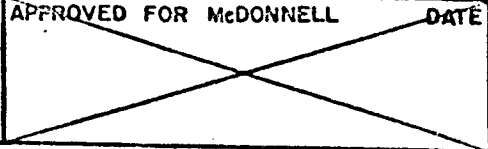
**DESIGN APPROVAL TEST OF COMPONENTS
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COMPONENT NAME THRUST CHAMBER - 25# PART NO. { MAC 52-52701-265
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3.8
(continued)

Cleaning of Test Setup Hardware:

The ten micron absolute stainless steel wire mesh filters shall be cleaned per Rocketdyne Specification RA0610-009 and stored in polyethylene bags until ready for use. Millipore filter housings shall be cleaned per Rocketdyne Specification RA0610-003 prior to installation of the new Millipore filter elements into the housings. The Millipore filter assemblies shall be stored in polyethylene bags until ready for use. The lines which are to be used between the test setup filters and the TCA shall be cleaned per Rocketdyne Specification RA0610-002 each time the filters are installed into test setup. Test setup hardware, which is too large for polyethylene bags shall be protected by appropriate closures, which have also been cleaned so as not to lower the level of cleanliness of the hardware.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
F. Adams	7-20-64	<i>R. Y. Eide</i>	8-4-64		
CHECKED BY:	DATE				
<i>W. J. Adams</i>	8-3-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
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3.9 Report

3.9.1 Data

Data shall be recorded directly on the applicable data sheets inserted after each test of this specification. All raw data shall be identified relative to the test to which it pertains. That raw data specifically requested by MAC Engineering shall be further identified relative to parameter measured, calibration factors, etc. and shipped to MAC, St. Louis. Reduced data shall include graphical presentations and time histories of all pertinent performance parameters.

3.9.2 Discussion of Data

In the final report all pertinent data obtained in the DAT series shall be analyzed and discussed. Any significant trends leading to pertinent conclusions or recommendation for further testing shall be covered.

3.9.3 Acceptance Test Data

Acceptance test log data shall be retained and be included as part of the final report for this component.

3.10 Component Test Modification

The propellant valve inlets of each TCA shall be modified following Pre-Test Inspection by the addition of an inlet tube adapter. Attachment of the adapter shall be by brazing in accordance with RAO607-009. Failure at the inlet adapter or the braze joint during subsequent testing shall not constitute a failure of the TCA.

PREPARED BY: <u>EA</u> E. Adams	DATE <u>6-8-64</u>	APPROVED FOR NAA: <u>[Signature]</u>	DATE <u>8-4-64</u>	APPROVED FOR McDONNELL	DATE
CHECKED BY: <u>[Signature]</u>	DATE <u>8-3-64</u>				
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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3.11 Sampling and Analysis of Propellants

Samples of propellants shall be obtained for analysis whenever propellants are introduced into the test facility tanks and at least once daily, during the time that DAT hot fire tests are conducted, for the purpose of specific gravity determination.

Samples of propellants shall be obtained for analysis whenever propellants are introduced into the test facility tanks and at least once weekly, during the time that DAT hot fire tests are conducted, for the purpose of propellant composition determination.

The data of the most recent analysis shall be recorded for each hot fire test. However, in the event that propellant tanks are filled between DAT hot fire test subsequent hot fire testing shall be delayed pending the results of the analysis of the new propellant.

3.12 Post Test Hardware Disposition

Upon successful completion of the Design Approval Tests, the components shall be cleaned as required for shipment, packaged in accordance with RA0616-008, and shipped directly to MAC, St. Louis. This shall not include components which fail during DAT and for which a failure analysis is required, except that components showing unusual failure modes shall be made available to MAC following Rocketdyne failure analysis.

PREPARED BY: E. Adams	DATE 8-8-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>[Signature]</i>	DATE 8-3-64	<i>[Signature]</i> 8-4-64			

FORM 608-B-40 NEW 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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3.13 Abbreviations

Abs	-	Absolute
AC	-	Alternating Current
cps	-	Cycles Per Second
DAT	-	Design Approval Tests
DC	-	Direct Current
DIGR	-	Direct Inking Graphic Recorder
F	-	Fahrenheit or Thrust
g	-	Standard Gravitational Acceleration
GN ₂	-	Gaseous Nitrogen
He	-	Helium
Hr	-	Hour
LVDT	-	Linear Variable Differential Transformer
MAC	-	McDonnell Aircraft Corporation
Min	-	Minute or Minimum
ml	-	Milliliter
MIP	-	Minimum Impulse Pulse
MMH	-	Monomethylhydrazine
NOM	-	Nominal
NTO	-	Nitrogen Tetroxide
OAMS	-	Orbit Attitude and Maneuver System
osc	-	Oscillograph or Oscilloscope
P	-	Pressure
psig	-	Pounds Per Square Inch Gauge
psia	-	Pounds Per Square Inch Absolute
RMS	-	Root Mean Square
SCC	-	Standard Cubic Centimeters
SCD	-	Specific Control Drawing
msec	-	Milliseconds
Sec	-	Seconds
T	-	Temperature
TCA	-	Thrust Chamber Assembly
V	-	Volts or Valve
U	-	Upper
L	-	Lower
F _T	-	Maximum Thrust

PREPARED BY: <i>EA</i>	DATE: <i>4/10/64</i>	APPROVED FOR NAA: <i>R. Eide</i>	DATE: <i>4-13-64</i>	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>W. J. ...</i>		<div style="border: 1px solid black; width: 100%; height: 100%; position: relative;"> </div>			
DATE: <i>4-10-64</i>					

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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
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3.14 Definitions

*Duration - Total time from "first indication" in starting sequence to 2%-of-maximum thrust point in the shutdown sequence.

Impulse, Mean Specific - Total impulse divided by total weight of propellants consumed.

Impulse, Specific - The thrust in pounds divided by the propellant consumption rate in pounds per second.

Impulse, Total - Area under the thrust-time curve.

*Pulse - A pulse includes all events from the "on signal" to 2-percent-of-maximum thrust point in the shutdown sequence.

*Signal, ON - The signal to open the propellant valves. This is the start of the starting sequence.

*Signal, OFF - The signal to close the propellant valves. This is the start of the shutdown sequence.

*Signal Width - Time from "on signal" to "off signal".

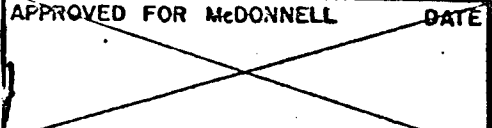
*Time, Start - Time from "on signal" to the 90 percent-of-maximum thrust point in the starting sequence.

*Time, Shutdown - Time from "off signal" to 2 percent-of-maximum thrust point in the shutdown sequence.

*Time, Effective Firing - Time from 90-percent-of-maximum thrust point in the start sequence to the 90-percent-of-maximum thrust point in the shutdown sequence.

Lockup Pressure - Pressure immediately upstream of the propellant valve prior to TCA operation.

* See Figure 10

PREPARED BY: E. Adams	DATE 8-10-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>Ed Dennis</i>	DATE 8-13-64	<i>R. J. Eide 8-13-64</i>			
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3.14
(cont'd)

Soakout Period - Time required for slowest TCA skin temperature to stabilize and drop 5°F to verify that peak temperature has been reached.

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PREPARED BY: E. Adams	DATE 10-15-64	APPROVED FOR NAA: <i>B. Hilde</i>	DATE 10-15-64	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>E. Adams</i>	DATE 10-15-64				

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REVISION A *J. D. Nary* Dated 10-15-64

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**DESIGN APPROVAL TEST OF COMPONENTS
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Reference: MAC SCD 52-52701, Revision F

4.0 Test Program

Three (3) Thrust Chamber Assemblies (P/N 208160-61), having passed the acceptance tests of RA0220-354, shall be subjected to Design Approval Tests (DAT) in accordance with the requirements presented in this specification. For purposes of identification during the DAT program, the three TCA's shall be designated one (1) through three (3) respectively.

4.1 Test Sequence

The following paragraphs list the TCA, the Applicable Environmental and Service Life Tests for each TCA and the operational tests and procedures which will be used to demonstrate SCD compliance. The tests for each TCA shall be performed in the order listed.

PREPARED BY: E. Adams	DATE 7-20-64	APPROVED FOR NAA: <i>B. Eide</i>	DATE 8-4-64	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>J. J. Jones</i>	DATE 8-3-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
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4.1.1 Thrust Chamber Assembly Number One		SCD
	Para.	Page Reference
Pre-Test Inspection	7.1.1	6.2.2.1
Weight Determination	6.6	6.3.1.4.1
Vibration	7.1.2	6.2.3.17.3
Propellant Valve Proof Pressure & Leakage	6.1	6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2	6.3.1.1.10
Propellant Valve Electrical Resistance	6.3	6.2.3.2
Propellant Valve Dielectric Strength	6.4	6.2.3.3
Propellant Valve Functional	6.5	6.3.1.3.1
Mechanical Shock	7.1.3	6.2.3.16
Propellant Valve Proof Pressure & Leakage	6.1	6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2	6.3.1.1.10
Propellant Valve Electrical Resistance	6.3	6.2.3.2
Propellant Valve Dielectric Strength	6.4	6.2.3.3
Propellant Valve Functional	6.5	6.3.1.3.1
DAT Duty Cycle to Failure	7.1.4	6.3.1.3.2.2
Disassembly and Inspection	7.1.5	6.2.3.20.1
Explosive Atmosphere (Prop Valves Only)	7.1.6	6.2.3.13
Propellant Valve Proof Pressure and Leakage	6.1	6.2.3.1
Propellant Valve Electrical Resistance	6.3	6.2.3.2
Propellant Valve Dielectric Strength	6.4	6.2.3.3
Propellant Valve Functional	6.5	6.3.1.3.1
Fuel and Oxidizer Resistance (Prop Valves Only)	7.1.7	6.2.3.18
Propellant Valve Electrical Resistance	6.3	6.2.3.2
Propellant Valve Functional	6.5	6.3.1.3.1
Propellant Valve Dielectric Strength	6.4	6.2.3.3
Propellant Valve Proof Pressure & Leakage	6.1	6.2.3.1
Propellant Valve Load Analysis	6.9	6.2.3.26

PREPARED BY: R. Cole <i>RC</i>	DATE 10-31-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 10-31-64	APPROVED FOR McDONNELL <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 10-31-64				

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**DESIGN APPROVAL TEST OF COMPONENTS
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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
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4.1.2 Thrust Chamber Assembly Number Two

	SCD Para. Page Reference	
Pre-Test Inspection	7.2.1	6.2.2.1
Weight Determination	6.6	6.3.1.4.1
Temperature Shock	7.2.2	6.2.3.7
Propellant Valve Proof Pressure & Leakage	6.1	6.2.3.1
Thrust Chamber Proof Pressure & Leakage	6.2	6.3.1.1.10
Propellant Valve Electrical Resistance	6.3	6.2.3.2
Propellant Valve Dielectric Strength	6.4	6.2.3.3
Propellant Valve Functional	6.5	6.3.1.3.1
Impulse Signal Width	7.2.3	6.3.1.3.2.2
DAT Duty Cycle to 160 Seconds	7.2.4	6.3.1.3.2.2
Weight Determination	6.6	6.3.1.4.1
Disassembly and Inspection	7.2.5	6.2.3.20.1

PREPARED BY: E. Adams	DATE 7-8-64	APPROVED FOR NAA: <i>R. B. Bide</i>	DATE 8-4-64	APPROVED FOR McDONNELL <i>[Signature]</i>	DATE <i>[Signature]</i>
CHECKED BY: <i>[Signature]</i>	DATE 8-3-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
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4.1.1 Thrust Chamber Assembly Number Three

	SCD	
	Para.	Page Reference
Pre-Test Inspection	7.3.1	6.2.2.1
Weight Determination	6.6	6.3.1.4.1
DAT Duty Cycle to 118 Seconds	7.3.2	6.3.1.3.2.2
Burst Pressure	7.3.3	6.3.1.3.2.2
Weight Determination	6.6	6.3.1.4.1
Disassembly and Inspection	7.3.4	6.2.3.20.1

PREPARED BY: E. Adams	DATE 7-8-64	APPROVED FOR NAA: <i>SA Eide</i>	DATE 8-4-64	APPROVED FOR McDONNELL <i>[Crossed out]</i>	DATE
CHECKED BY: <i>Robert [unclear]</i>	DATE 8-3-64				

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**DESIGN APPROVAL TEST OF COMPONENTS
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Reference: MAC SCD 52-52701, Revision F

5.0 EQUIPMENT AND MATERIAL (Equivalent items may be used)

5.1 Material

5.1.1 Nitrogen Tetroxide - MIL-P-26529A (Oxidizer) (0.3% H₂O Permitted)

5.1.2 Monomethyl Hydrazine - MIL-P-27404A (Fuel)

5.1.3 Nitrogen Gas - MIL-P-27401A

5.1.4 Freon TF - Commercial Grade

5.1.5 Helium - Federal Stock Number 6830-283-9842

5.1.6 Alcohol - MIL-A-6091B (Reagent Grade Isopropyl Alcohol Am. Chem. Soc. Standard is considered equivalent).

5.1.7 Leak Test Compound - MIL-L-25567

5.1.8 Water - Distilled and/or De-ionized (pH: 6.5 to 7.5)

5.2 Special Equipment

5.2.1 Hot Fire Facility

A facility capable of static firing the TCA's at both ambient conditions and at a simulated pressure altitude of 100,000 feet or greater.

Suitable equipment to provide and utilize hot GN₂ purge, Anhydrous Isopropyl Alcohol and Freon TF fluids for decontamination, flushing and cleaning the TCA after firing.

The facility shall be equipped to meet the instrumentation requirements of Table I.

PREPARED BY: E. Adams	DATE 4/14/64	APPROVED FOR NAA: <i>R. Heide</i>	DATE 4-14-64	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>W. Adams</i>	DATE 4/14/64				

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**DESIGN APPROVAL TEST OF COMPONENTS
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5.2.1
(cont'd)

The facility shall be equipped with a thrust mount designed for thrust vector determination during steady state operation. The facility shall be equipped with a high natural frequency thrust mount for axial thrust determination during DAT duty cycle operation and impulse signal width tests.

The facility shall be equipped with a TCA firing control system consisting of a pulse generator, automatic tape programmer, TCA control panel, TCA power distribution panel and a regulated DC power supply. The TCA installation wiring is shown in MAC SCD 52701, Revision F, Figure 18. The automatic tape programmer shall be capable of controlling the pulse sequence and duration of Table II, and instrumentation recording sequence of Table III, and Table IV.

The facility shall be equipped with a propellant feed system per Figure 6.

5.2.2

Vibration Testing Facility

The facility shall be capable of vibrating the TCA at frequencies of 5 to 2000 cps and at the random vibration power spectral density per Figure 8.

The facility shall be equipped with a servo control unit for varying the vibration frequency logarithmically.

The facility shall be equipped with a Ling ASDE 80 equalization console and a Ling power amplifier to control the random vibration input.

The facility shall be equipped with a test fixture to which the TCA can be attached by employing simulated spacecraft brackets and use of its attach points shown in Figure 7. The test fixture

PREPARED BY: E. Adams	DATE 7-15-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 8-4-64	APPROVED FOR McDONNELL <i>[Signature]</i>	DATE
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5.2.2
(cont'd)

shall be capable of being mounted on the vibration machine such that the TCA can be vibrated along each of the three mutually perpendicular axes shown in Figure 7. Provision shall be made for attaching the extended propellant valve inlet lines to the test fixture.

The facility shall be equipped with accelerometers with an accuracy of $\pm 5\%$ from 5 to 2000 cps, and a natural frequency over 30,000 cps.

The facility shall be equipped with a multichannel oscillograph for recording the accelerometer output during the vibration sweeps.

The facility shall be equipped with a multichannel FM magnetic tape recorder for recording the accelerometer output during the random vibration.

The facility shall be equipped with a Ballantine True RMS Meter to measure the RMS G acceleration.

The facility shall be equipped with a Technical Products Company analyzer to analyze the accelerometer output power spectral density shape.

5.2.3

Temperature Chamber (Non-Firing)

An enclosure in which the TCA or the TCA propellant valves can be exposed to air temperatures of -40 to 200F. The temperature chamber shall be capable of maintaining any specified temperature within this range to $\pm 5F$. The air temperature shall be continuously recorded. The internal volume shall be sufficient so that all applicable test procedures can be accomplished. Instrumentation shall be provided for continuous recording of chamber temperatures.

PREPARED BY: E. Adams	DATE 7-15-64	APPROVED FOR NAA: <i>R. Eide</i>	DATE 8-4-64	APPROVED FOR McDONNELL	DATE
CHECKED BY: <i>P. J. Jones</i>	DATE 8-3-64				

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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. 208160-401 SHEET 21 OF 380

5.2.4

Shock Testing Facility

The facility shall be capable of imparting half sine wave shocks of 15 ± 1.5 g magnitude and 11 ± 1.0 millisecond duration to the TCA.

The facility shall be equipped with a rigid jig test fixture to which the TCA shipping container, as specified in RA0616-008, can be rigidly attached. The rigid jig test fixture shall be capable of being mounted on the shock machine such that the TCA, in its shipping container, can be shocked along the plus and minus direction of each of the three mutually perpendicular axes shown in Figure 7. The facility shall be equipped with an accelerometer.

The facility shall be equipped with an accelerometer (Statham, Model A5TCA-50-350) which shall be mounted on the rigid jig test fixture.

The facility shall be equipped with an oscilloscope (Tektronix, Model 535 or 564) for monitoring the accelerometer output and recorded on a Polaroid camera.

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**DESIGN APPROVAL TEST OF COMPONENTS
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5.2.5 Electronic Cyclor

A device which can be used to cycle the propellant valves at cycle rates of 1, 2, 3, 4 and 5 cycles per second. A cycle shall consist of poppet travel from closed to open to closed. The cyclor shall include a counter for counting the cycles.

5.2.6 Electrical Harness

A moisture proof jumper assembly incorporating at one end two Bendix MG06-8-4S plugs potted in accordance with RA0106-006. Each lead shall be identified according to valve (oxidizer or fuel) and pin (A, B, C or D). See Figure 1. This electrical harness shall be used whenever electrical power is supplied to the TCA.

5.3 Standard Pneumatic and Hydraulic Equipment (Ref. Fig. 2,3,4 & 11)

5.3.1 Pressure Gages

G₁, G₂ - 0 to 600 psig, $\pm 1/4\%$ accuracy, full scale

5.3.2 Valves

V₁, V₂, V₃ - 1/4" hand valve, 0 to 1000 psig

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5.3.3 Regulators

R₁ - 1/4" pressure regulator, 0 to 1000 psig

5.3.4 Filters

F₁ - Filter, 10 micron absolute, stainless steel wire mesh

F₂ - Millipore filter, CA12 440 00; Housing, MS 28720-12

5.4 Standard Electrical Equipment

(Equivalent items may be used)

5.4.1 DC Power Supply - 0 to 36 VDC

5.4.2 AC Power Supply - 110 VAC nominal, 60 cps

**5.4.3 Oscilloscope - Hewlett Packard, Model 122 AR, dual trace
(for Propellant Valve Functional)**

5.4.4 Switch - 40 watt minimum power rating

5.4.5 High Voltage Leak Detector - Associated Research, Model 411

5.4.6 Impedance Bridge - 0 to 50 ohms, $\pm 1/10\%$ accuracy

**5.4.7 Voltmeter - Hewlett Packard, Model 412A, 0 to 30 VDC and
0 to 100 VDC, $\pm 1\%$ full scale accuracy**

5.4.8 Temperature Recorder - Leeds and Northrop, $\pm 3\%$ accuracy

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- 5.4.9 Thermocouple - bare wire junction, accuracy class D defined in RAO201-050
- 5.5 Standard Leakage Testing Equipment
- 5.5.1 Burette - 25 ml, 0.1 ml graduations
- 5.5.2 Beaker - 400 ml
- 5.6 Miscellaneous Equipment
- 5.6.1 Pressure Test & Water Flow Fixture P/N T5034515
- 5.6.2 Camera - Polaroid (with oscilloscope adapter)
- 5.6.3 Propellant Valve Inlet Adapter - P/N 99-106126
- 5.6.4 Wall Temperature Test Chamber - P/N 99-208159
- 5.6.5 Scale - 0 to 25 pounds, 0.01 pound subdivisions
- 5.6.6 Stop Watch - One second subdivisions
- 5.7 Special Equipment
- 5.7.1 High Response Thrust Fixture (including isolation Mass and Load Cell. (Kulite - Bytrex Load Cell JP1000 series)
- 5.7.2 Two (2) Piston Flowmeters including LVDT's (Collins, 4 inch total travel)
- 5.7.3 Quantum Dynamics Bessel Low-Pass Filter (Type EBF -104)

PREPARED BY: <i>ef</i> E. Adams	DATE 4/10/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 4-13-64	APPROVED FOR McDONNELL <i>[Signature]</i>	DATE
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- 5.7.4 10 KC Excitation Source for LVDT's
- 5.7.5 Demodulator Chassis for LVDT's
- 5.7.6 Remotely Controlled Dead Weight Calibrator for Thrust Fixture
- 5.7.7 CEC Type 33 Oscillograph Paper or Equivalent
- 5.7.8 Dymac DY 2401 Integrating Digital Voltmeter
- 5.7.9 Milliammeter, Weston Model 1951, 0-200 MA Range

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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST OPERATIONAL TESTS AND PROCEDURES TEST NO. 208160-401 SHEET 26 OF 380

Reference: MAC SCD 52-52701, Revision F

6.0 Operational Tests and Procedures

This section contains the test procedures which shall be used in conjunction with the Environmental and Service Life Tests to demonstrate SCD compliance.

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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE { NAA 208160-61
NAME OF TEST AND LEAKAGE TEST NO. 208160-401 SHEET 27 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.3.1

- 1 Propellant Valve Proof Pressure and Leakage
- 6.1.1 Install the TCA in a test setup as shown in Figure 2. If the propellant valves have been removed from the TCA, they shall be equipped with propellant valve outlet adapters. Do not attach the leakage sensing line at this time.
- NOTE: It shall be necessary to perform this test in a hazardous test cell. See paragraph 3.8.
- 6.1.2 Slowly adjust the regulated helium supply pressure at the oxidizer propellant valve inlet to 500 ± 10 psig as indicated by the pressure gage.
- 6.1.3 Maintain this pressure for a period of not less than three minutes.
- 6.1.4 De-pressurize the oxidizer propellant valve.
- 6.1.5 Adjust the regulated helium supply pressure to 150 ± 10 psig.
- 6.1.6 Adjust the DC power supply to 26 ± 0.5 VDC.
- 6.1.7 Cycle the oxidizer propellant valve three times and leave in the closed position.
- 6.1.8 Attach the leakage sensing line and arrange the leakage testing equipment as shown in Figure 2.
- 6.1.9 Adjust the regulated helium supply pressure to 500 ± 10 psig.

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**DESIGN APPROVAL TEST OF COMPONENTS
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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST NO. 208160-401 SHEET 28 OF 380

- 6.1.10 At first indication of leakage, wait at least two minutes to insure a steady leakage rate and then measure the leakage over a period of at least five minutes with a stopwatch. If no leakage is apparent after five minutes or if the measured leakage is less than 0.5 ml, record the leakage rate at "less than 0.1 scc He/MIN." The maximum allowable leakage is 2.23 scc He/MIN.
- 6.1.11 De-pressurize the oxidizer propellant valve. Disconnect the helium supply line, the DC power supply and the leakage sensing line. Cap the oxidizer propellant valve inlet port and electrical receptacle.
- 6.1.12 Failure to pass the above tests shall constitute a failure of the oxidizer valve. See paragraph 3.6.1.
- 6.1.13 Repeat the above procedure on the fuel propellant valve.
- 6.1.14 Remove the TCA from the test setup. Replace all protective covers.

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R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAME OF TEST THRUST CHAMBER PROOF PRESSURE AND LEAKAGE { NAA 208160-61
TEST NO. 208160-601 SHEET 29 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.I.10

6.2 Thrust Chamber Proof Pressure and Leakage

6.2.1 Install the TCA in a test setup as shown in Figure 3.
NOTE: It shall be necessary to perform this test in a hazardous test cell. See paragraph 3.8.

6.2.2 Close valve V₁.

6.2.3 Apply leak test compound to all welds on the TCA and to the transition joint between the stainless steel shell and the ablative material on the TCA nozzle exterior.

6.2.4 Energize the fuel propellant valve with 12 ± 2 VDC.

6.2.5 Slowly increase the regulated GN₂ supply pressure to 392 ± 10 psig. Maintain this pressure for a period of $3 \pm .25$ minutes. Evidence of leakage in the areas specified in paragraph 6.2.3, shall constitute a failure of the TCA.

6.2.6 Reduce the regulated GN₂ pressure to zero and de-energize the fuel valve.

6.2.7 Repeat paragraphs 6.2.3 through 6.2.6.

6.2.8 Failure to pass the above test shall constitute a failure of the TCA. See paragraph 3.6.

6.2.9 Wash residual leak test compound from the TCA with water and blow dry with GN₂.

6.2.10 Remove the TCA from the test setup and replace all protective closures.

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**DESIGN APPROVAL TEST OF COMPONENTS
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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
-401
NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO. 208160 SHEET 30 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.3.2

6.3 Propellant Valve Electrical Resistance

- 6.3.1** Install the electrical harness on the propellant valves. Provide an environmental temperature of 70 \pm 5 F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than \pm 3 F for a 30 minute time period.
- 6.3.2** Adjust the impedance bridge to measure resistance.
- 6.3.3** Measure and record the resistance between leads A and B of the oxidizer valve. The acceptable resistance is presented in Figure 9.
- 6.3.4** Measure and record the resistance between leads C and D of the oxidizer valve. The maximum acceptable resistance is 1.0 ohm.
- 6.3.5** Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.
- 6.3.6** Repeat paragraphs 6.3.3 and 6.3.4 on the fuel valve.
- 6.3.7** Remove Electrical harness from propellant valves and replace protective covers on propellant valve electrical connectors.

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Rev. A/P. *[Signature]* Date 12-16-64

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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
PROPELLANT VALVE DIELECTRIC { NAA 208160-61
NAME OF TEST STRENGTH TEST NO 208160-401 SHEET 31 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.3.3

6.4 Propellant Valve Dielectric Strength

- 6.4.1 Install the electrical harness on the propellant valves. Attach ground leads to each of the propellant valve electrical connector bodies by means of alligator clips.
- 6.4.2 Adjust the 60 cps AC voltage output of the leakage tester to zero.
- 6.4.3 Set the capacity compensation selector switch on the leakage tester to "NONE".
- 6.4.4 Connect one of the leakage tester leads to lead A of the oxidizer valve and the other lead to the oxidizer valve ground lead.
- 6.4.5 Depress power switch on the leakage tester, and adjust the voltage control until 500 ± 10 VRMS is indicated on the voltmeter. If the leakage tester ammeter reads off-scale, reduce the voltage until approximately 800 microamps is indicated on the ammeter.
- 6.4.6 Rotate the capacity compensation selector switch until a minimum current flow is indicated on the ammeter.
- 6.4.7 Adjust the voltage control until 500 ± 10 VRMS is indicated on the voltmeter.
- 6.4.8 Observe the ammeter for a period of one minute. Maximum allowable current leakage is 500 micro-amps.
- 6.4.9 Release the leakage tester power switch and disconnect the leakage tester leads.

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E. Adams	<i>Ry Eide</i> <i>4-13-64</i>	
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**DESIGN APPROVAL TEST OF COMPONENTS
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NAA 208160-61
NAME OF TEST PROPELLANT VALVE DIELECTRIC TEST NO. 208160-401
STRENGTH SHEET 32 OF 380

- 6.4.10 Repeat paragraphs 6.4.2 and 6.4.3
- 6.4.11 Connect one of the leakage tester leads to lead C of the oxidizer valve and the other lead to the oxidizer valve ground lead.
- 6.4.12 Repeat paragraphs 6.4.5 through 6.4.9.
- 6.4.13 Repeat paragraphs 6.4.2 and 6.4.3.
- 6.4.14 Connect one of the leakage tester leads to lead A of the oxidizer valve and the other to lead C of the oxidizer valve.
- 6.4.15 Repeat paragraphs 6.4.5 through 6.4.9.
- 6.4.16 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.
- 6.4.17 Repeat paragraphs 6.4.2 through 6.4.15 on the fuel valve.
- 6.4.18 Remove the electrical harness and the ground leads from the propellant valves and replace the propellant valve protective covers.
- 6.4.19 Replace protective caps.

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COMPONENT NAME THRUST CHAMBLR ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 208160-401 SHEET 33 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.1

6.5 Propellant Valve Functional

- 6.5.1 Install the TCA in a test setup as shown in Figure 4. Provide a temperature environment of 70 ± 5 F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than ± 3 F for a 30 minute time period. Connect the current trace lead to the oxidizer valve. Do not connect the voltage trace lead.
- 6.5.2 Adjust the pressure regulator to obtain 300 ± 10 psig on the pressure gage.
- 6.5.3 Adjust the DC power supply so that 26 ± 0.5 VDC is read on the voltmeter.
- 6.5.4 Close the mercury switch and record the oscilloscope current trace with the Polaroid camera. A sample current trace is shown in Figure 5. The maximum valve opening response time is 0.0065 seconds from electrical signal to poppet open. See Figure 5 for typical valve opening response characteristics. Open the mercury switch.
- 6.5.5 Reduce the GN_2 supply pressure to zero.
- 6.5.6 Disconnect the current trace lead and connect the voltage trace lead.
- 6.5.7 Close the mercury switch to verify that the oxidizer valve has opened. Then open the mercury switch and record the oscilloscope voltage trace with the Polaroid camera. A sampling voltage trace is shown in Figure 5. The maximum valve closing response time is 0.0035 seconds from electrical signal to poppet closed.

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NAA 208160-61
NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 208160-401 SHEET 34 OF 380

- 6.5.8 Adjust the GN₂ supply pressure to 300 \pm 10 psig.
- 6.5.9 Adjust the DC power supply voltage to zero.
- 6.5.10 Close the mercury switch.
- 6.5.11 Increase the DC power supply voltage until the oxidizer valve opens as indicated by a pressure drop. The maximum acceptable pull in voltage is 16 VDC as indicated on the output voltmeter.
- 6.5.12 Reduce the GN₂ supply pressure to zero.
- 6.5.13 Reduce the DC power supply voltage until the propellant valve closes. Note deflection on milliammeter which indicates valve closing. Record valve closing voltage. The minimum acceptable drop out voltage is 1.0 volts.
- 6.5.14 Open the mercury switch.
- 6.5.15 Failure to pass the above test shall constitute a failure of the oxidizer valve. See paragraph 3.6.
- 6.5.16 Repeat paragraphs 6.5.1 through 6.5.15 on the fuel propellant valve.
- 6.5.17 Remove electrical leads and the GN₂ supply.
- 6.5.18 Replace all protective closures.

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COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST WEIGHT DETERMINATION TEST NO. 208160-401 SHEET 35 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.4.1

6.6 Weight Determination

6.6.1 Weigh the TCA to the nearest one-hundredth (0.01) pound in accordance with RAO220-290 and record.

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DESIGN APPROVAL TEST OF COMPONENTS

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 254 PART NO. { MAC 52-52701-265
THRUST CHAMBER ASSEMBLY { NAA 208160-61
NAME OF TEST FIRING PROCEDURE TEST NO. 208160-101 SHEET 36 OF 380

Reference: MAC SCD 52-52701 Revision F, paragraph 6.3.1.3.2.2

6.7 Thrust Chamber Assembly Firing Procedures

6.7.1 Install the TCA in a thrust mount located in a hot fire test installation equipped with instrumentation per Table I. Pressure check all connections using GN₂ at 50 ±10 psig, seal assembly 9017831, and leak test compound.

6.7.1.1 For cape cycle firings, the firing duration shall be controlled automatically. The required propellant feed system is shown schematically in Figure 6.

6.7.1.2 For DAT duty cycle firings the firing control shall be automatic. The pulse sequence and duration shall be according to the schedule of Table II. The required propellant feed system is shown schematically in Figure 6.

6.7.1.3 For impulse signal width tests, the firing control system shall be controlled by the pulse generator. The required propellant feed system is shown schematically in Figure 6 .

6.7.2 Open facility propellant valves.

6.7.3 Pressurize facility propellant tanks to approximate run pressures.

6.7.4 Open the oxidizer bleed valve to bleed entrained gas from the oxidizer feed system. Continue bleeding until entrained gas is eliminated as evidenced by a steady oxidizer flowmeter signal.

6.7.5 Close oxidizer bleed valve.

6.7.6 Repeat paragraphs 6.7.4 and 6.7.5 on the fuel feed system.

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J.A. Ganger 9/29/64	B. Heide 9-29-64	
CHECKED BY: DATE		
W. Dennis		

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Revision A D. Warrigens Dated 9-29-64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
THRUST CHAMBER ASSEMBLY { NAA 203160-61
NAME OF TEST FIRING PROCEDURE TEST NO. 208160-LO1-SHEET 37 OF 380

6.7.7 ☒ Activate altitude chamber to achieve and maintain a simulated pressure altitude of 100,000 feet or greater. If the firing is to be capo cycle the pressure altitude shall be local ground level.

6.7.8 ☒ Make final propellant tank pressure adjustments to obtain the required TCA inlet pressures during steady state operation as follows:

Oxidizer Inlet Pressure 292 \pm 10 psia
Fuel Inlet Pressure 292 \pm 10 psia

6.7.9 ☒ Turn on instrumentation. The parameters tabulated in Table I shall be monitored and recorded during the hot fire test.

6.7.10 ☒ Fire TCA as required to accomplish test objectives.

6.7.11 ☒ Immediately following termination of firing reduce pressure altitude to local ground level conditions. Close the facility propellant valves and adjust GN₂ purge pressurant to 120 \pm 10 psig.

- NOTE: (1) Maintain altitude following the completion of the DAT Duty Cycle to minimum duration. Record temperature data during the soak out period of 20 \pm 5 minutes. After soak out temperature is reached complete the Hot Fire Burst Pressure Test procedure of paragraph 7.2.4. TCA skin temperature must not exceed 700 °F after MDC soakout.
- (2) Maintain altitude following the completion of the DAT Duty Cycle to Guaranteed Life. Record temperature data during the soak out period of 20 \pm 5 minutes. No failure criteria shall be attached to the soakout temperature after the MDC to guaranteed life.

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J.A. Ganger	9/29/64	<i>R. Heide</i>	9-29-64		
CHECKED BY:	DATE				
<i>R. Dennis</i>					

FORM 608-B-38 NEW 6-63

Revision A *D. Morris*
Dated 9-29-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

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NAA 208160-61
NAME OF TEST THRUST CHAMBER ASSEMBLY TEST NO. 208160-401
FIRING PROCEDURE SHEET 38 OF 380

- 6.7.12 Open the propellant bleed valves and purge with GN₂ for a period of 30 seconds (minimum).
- 6.7.13 Close the propellant bleed valves.
- 6.7.14 Cycle the TCA oxidizer and fuel valves three times simultaneously and leave in the open position.
- 6.7.15 Continue to purge for two minutes maintaining ambient conditions throughout.
- 6.7.16 Close the TCA oxidizer and fuel valves.
- 6.7.17 Secure the test facility.
- 6.7.18 Remove the TCA from the hot fire test installation.

PREPARED BY: <i>EA</i>	DATE: <i>4/10/64</i>	APPROVED FOR NAA: <i>H. Heide</i>	DATE: <i>4-13-64</i>	APPROVED FOR McDONNELL: <i>[X]</i>	DATE: <i>[X]</i>
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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208160-401 SHEET 39 OF 300

6.8 Decontamination Procedure

6.8.1 The TCA shall be decontaminated as follows, using a hot GN₂ purge and anhydrous isopropyl alcohol, reagent grade, ACS, for the fuel side flush and feon TF for the oxidizer side flush.

NOTE: The hot GN₂ purge may be accomplished at the hot fire test facility.

6.8.2 Attach 10 VDC (nominal) electrical power supply leads to the oxidizer valve electrical connectors.

6.8.3 Connect GN₂ purge line to the oxidizer valve inlet. See paragraph 3.8.

6.8.4 Open the GN₂ supply valve and purge the oxidizer side for ten minutes using 12 ±2 VDC to open the oxidizer valve.

NOTE: The GN₂ pressure and temperature, at the valve inlet, shall be 120 ±20 psig and 160 ±20°F, respectively.

6.8.5 Open the GN₂ supply valve and purge the oxidizer side as follows for ten (10) cycles.

- (a) 5 +1 seconds on-time
- (b) 5 ±1 seconds off-time

NOTE: The GN₂ pressure and temperature, will be same as paragraph 6.8.4.

6.8.6 Close the GN₂ supply valve and vent the GN₂ downstream of the supply valve.

6.8.7 Disconnect the supply line from the oxidizer valve.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE	<i>[Signature]</i> 10-20-64		<i>[Signature]</i>	
<i>[Signature]</i> 10-20-64					

FORM 608-B-38 NEW 6-63

Rev. A *[Signature]* dated *10/21/64*

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208160-701 SHEET 40 OF 380

- 6.8.8 Cap the valve adapter and disconnect the electrical connector.
- 6.8.9 Repeat paragraph 6.8.1 through 6.8.8 on the fuel valve..
- 6.8.10 Install the TCA in the decontamination facility.
- 6.8.11 Attach the facility alcohol supply line to the TCA fuel valve.
- 6.8.12 Cap the TCA oxidizer inlet line.
- 6.8.13 Install the electrical harness on the propellant valves and connect the harness to the DC power supply.
- 6.8.14 Energize the TCA fuel valve to the open position with 12 ± 2 VDC.
- 6.8.15 Flow alcohol through the TCA for $2 \pm \frac{1}{10}$ minutes. The alcohol shall be flowed at a TCA inlet pressure of 35 to 50 psig.
- 6.8.16 Flow alcohol through the TCA as follows for ten (10) cycles, using 26 ± 1 VDC at a TCA inlet pressure of 35 to 50 psig.
- (a) 5 ± 1 seconds on-time
- (b) 5 ± 1 seconds off- time
- 6.8.17 De-energize the TCA fuel valve to closed position and vent the alcohol supply system.
- 6.8.18 Remove the facility alcohol line and attach the GN_2 supply line to the TCA fuel valve.
- 6.8.19 Energize the TCA fuel valve to the open position with 12 ± 2 VDC.
- 6.8.20 Purge the TCA with GN_2 at pressure of 120 ± 10 psig for 3 minutes.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>R. Cole</i>	DATE 10-20-64	<i>R. Cole</i> 10-20-64			

FORM 608-B-38 NEW 6-63

Rev. A *J. D. Margolis* dated *10/21/64*

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208160-401 SHEET 40 OF 380

- 6.8.21 Cycle valve ten (10) times with GN₂ at a pressure of 120 \pm 10 psig as follows using 26 \pm 1 VDC. A
- (a) 5 \pm 1 seconds on-time
(b) 5 \pm 1 seconds off-time
- 6.8.22 De-energize the TCA fuel valve to the closed position.
- 6.8.23 Disconnect GN₂ line from TCA fuel valve and cap the fuel valve inlet.
- 6.8.24 Remove cap from TCA oxidizer valve inlet.
- 6.8.25 Attach Freon TF supply line to TCA oxidizer valve inlet.
- 6.8.26 Energize TCA oxidizer valve to open position with 12 \pm 2 VDC.
- 6.8.27 Flow Freon TF through the TCA for 2 \pm 1 minutes. The Freon shall be flowed at a TCA inlet pressure of 35 to 50 psig.
- 6.8.28 Flow Freon TF through the TCA as follows for ten (10) cycles, using 26 \pm 1 VDC at a TCA inlet pressure of 35 to 50 psig. A
- (a) 5 \pm 1 seconds on-time
(b) 5 \pm 1 seconds off-time
- 6.8.29 De-energize TCA oxidizer valve to closed position and vent the Freon supply system.
- 6.8.30 Disconnect Freon Supply line and attach GN₂ supply to TCA oxidizer inlet.
- 6.8.31 Energize the TCA oxidizer valve to open position with 12 \pm 2 VDC.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: <i>[Signature]</i>	DATE 10-20-64	APPROVED FOR McDONNELL: <i>[X]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 10-20-64				

FORM 608-B-38 NEW 6-63

Rev. A *J. D. Macgregor* dated *12/21/64*

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-205
NAA 208160-61
NAME OF TEST DECONTAMINATION PROCEDURE TEST NO. 208160-401 SHEET 41 OF 580

- 6.8.32 Purge the TCA with GN₂ at a pressure of 120 \pm 10 psig for 3 minutes.
- 6.8.33 Cycle valve ten (10) times with GN₂ at a pressure of 120 \pm 10 psig as follows using 26 \pm 1 VDC.
 - (a) 5 \pm 1 seconds on-time
 - (b) 5 \pm 1 seconds off-time
- 6.8.34 De-energize the TCA oxidizer valve to closed position.
- 6.8.35 Remove the GN₂ supply line from the TCA oxidizer valve and cap the oxidizer valve inlet.
- 6.8.36 Connect 10 VDC (nominal) power supply to the TCA fuel valve so that the propellant valves may be energized simultaneously.
- 6.8.37 Uncap both TCA propellant inlets and place TCA in a vacuum oven.
- 6.8.38 Attach temperature sensing elements to one propellant valve and the injector upper face.
- 6.8.39 Heat the TCA to indicated temperature of 150 \pm 10 F.
- 6.8.40 Energize both TCA propellant valves and activate the vacuum equipment so that the TCA is subjected to an internal pressure of one (10) psia or less for a period of not less than fifteen (15) minutes. The TCA valve and injector temperature shall be maintained at 150 \pm 10 F during the specified time period.
- 6.8.41 Remove electrical leads and install all protective covers.

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA: <i>[Signature]</i>	DATE 10-29-64	APPROVED FOR McDONNELL: <i>[X]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 10-20-64				

FORM 608-B-38 NEW 6-63

Rev. A *[Signature]* dated 10/21/64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208160-401 SHEET 41 OF 380

6.9 Propellant Valve Orifice Removal

6.9.1 Remove oxidizer and fuel valve tube assemblies (P/N 407571) from TCA.

6.9.2 Remove retaining rings and orifices.

NOTE: Use caution in removing orifices to prevent damage.
 (Reference paragraph 3.8 for cleanliness requirements)

6.9.3 Package and identify each orifice and retaining ring.

6.9.4 Reweld tube assemblies to the propellant valves.

6.9.5 Secure packaged orifices and retaining rings to the applicable valves.

6.9.6 Perform 500 psig leak check to verify structural integrity of weld joints.

6.9.7 Reidentify TCA 208160-61 as 208160-61 DAT.

PREPARED BY: E. Adams	DATE 9-30-64	APPROVED FOR NAA: <i>R. Heide</i>	DATE 10-8-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE <i>[Signature]</i>
CHECKED BY: <i>R. G. G.</i>	DATE 10-8-64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO. 208160-401 SHEET 1.2 OF 380 D

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.1.2.

6.10 Propellant Valve Load Analysis

- 6.10.1** Install the propellant valve in a test setup as shown in Figure 14. Connect the oscillograph to monitor propellant valve current and voltage versus time. Set the "PULL IN - DRCP OUT" switch of the propellant valve test panel to "PULL IN". Leave the line switch in the open position. See paragraph 3.8.
- 6.10.2** Adjust the regulated GN₂ supply pressure to 300 \pm 10 psig.
- 6.10.3** Set "VALVE DC POWER" switch to "ON".
- 6.10.4** Adjust DC power supply so that 20 \pm 0.5 VDC is indicated on the output voltmeter.
- 6.10.5** Set "VALVE DC POWER" switch to "OFF" and close the line switch.
- 6.10.6** Adjust oscillograph paper speed for 60 inches per second. Activate the oscillograph.
- 6.10.7** By use of the "VALVE DC POWER" switch energize the propellant valve for approximately 200 milliseconds or more to obtain oscillograph traces of current and voltage versus time. The trace shall include energize and de-energize transients and steady state conditions.
- 6.10.8** Deactivate the oscillograph and inspect the oscillograph traces to determine the voltage and the current at that point in time which makes the power a maximum. Power in watts is defined as the product of voltage in volts and current in amps. Record the current, voltage and power on the data sheet.

PREPARED BY: <u>R. Cole</u>	DATE <u>10-31-64</u>	APPROVED FOR NAA: <u>[Signature]</u>	DATE <u>10-31-64</u>	APPROVED FOR McDONNELL: <u>[Signature]</u>	DATE <u>10-31-64</u>
CHECKED BY: <u>[Signature]</u>	DATE <u>10-31-64</u>				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO. 208160-401 SHEET 11 OF 380 D

- 6.10.8.1 Load analysis is performed primarily for information purposes. However, a requirement exists that when this test is run at valve body temperatures of 160F the power consumption of the propellant valve shall not exceed 20 watts when the energizing voltage is 26 \pm 4 VDC. Failure to pass this requirement shall constitute a failure of the propellant valve.
- 6.10.9 Record on the oscillograph trace the propellant valve serial number, the applied voltage and the environmental temperature.
- 6.10.10 Repeat paragraphs 6.10.3 through 6.10.9 for voltages of 22, 24, 26, 28, 30 and 33 VDC.
- 6.10.11 Reduce the regulated GN₂ supply pressure to zero.

PREPARED BY: R. Cole <i>RC</i>	DATE 10-31-64	APPROVED FOR NAA: <i>R. Cole</i>	DATE 10-31-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE 10-31-64
CHECKED BY: <i>[Signature]</i>	DATE 10-31-64				

FORM 608-9-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST ENVIRONMENTAL AND SERVICE LIFE TEST NO. 208160-401 SHEET 42 OF 380

Reference: a) MAC SCD 52-52701, Revision F, Figure 12

7.0 Environmental and Service Life

In this section the required environment, service life and operational tests are specified for each of the three TCA's. Sheets are provided for the recording of environmental and service life data and the data of the operationsl tests required to demonstrate specification compliance.

PREPARED BY: <i>EA</i> DATE <i>4/10/64</i>	APPROVED FOR NAA: DATE	APPROVED FOR McDONNELL: DATE
CHECKED BY: <i>W. J. Adams</i> DATE <i>4-16-64</i>	<i>R. J. Hilde</i> <i>4-13-64</i>	

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST ENVIRONMENTAL AND SERVICE LIFE TESTS TEST NO. 208160-401 SHEET 43 OF 380

Reference: MAC SCD 52-52701, Revision F, Figure 12

7.1 Thrust Chamber Assembly No. 1

This sub-section specified the tests which are to be performed on TCA No. 1.

PREPARED BY: E. Adams	DATE 4/10/64	APPROVED FOR NAA:	DATE 4-13-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE				

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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-401 SHEET 44 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.2.1

7.1.1 Pre-Test Inspection - TCA #1

7.1.1.1 Test Procedure

7.1.1.1.1 Verify that the TCA is of the proper configuration and has passed the Acceptance Tests of Rocketdyne specification RA0220-354. Only the TCA's that comply with the above requirements shall be accepted for DAT.

7.1.1.1.2 Record the Rocketdyne Part Number and Serial Number of the TCA.

7.1.1.1.3 Record the Rocketdyne Part Number and Serial Number of the oxidizer propellant valve.

7.1.1.1.4 Record the Rocketdyne Part Number and Serial Number of the fuel propellant valve.

7.1.1.1.5 Record the McDonnell Part Number of the TCA.

7.1.1.1.6 Inspect the TCA for visual evidence of damage or deterioration. Comment on all visual defects.

7.1.1.1.7 Braze the extended propellant valve tube inlet adapters (P/N 99-106694 and 99-106695) to the fuel and oxidizer inlet tube stubs as defined in Rocketdyne process specification RA0607-009. Remove after vibration test and braze basic inlet tube adapters (P/N 99-106126) to TCA.

7.1.1.1.8 Perform weight determination on TCA with basic inlet tube adapters per paragraph 6.6.

PREPARED BY: E. Adams	DATE 5/22/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 8-4-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 8-3-64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-101 SHEET 45 OF 380

7.1.1.2 Test Results - TCA #1

7.1.1.2.1 Component Identification

Component Name	TCA	Oxidizer Valve	Fuel Valve
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McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058233

7.1.1.2.2 Inspection (reference paragraph 7.1.1.1)

7.1.1.2.2.1 The TCA was inspected and found to be of the proper configuration and had passed the acceptance tests of RAC 220-354.

YES (Yes or No) 8/27/64

7.1.1.2.2.2 The extended inlet tube adapters were installed on the propellant valves per paragraph 7.1.1.1.7 for vibration tests only.

NO (Yes or No) REF. PARA. 7.1.1.2.2.4 7-27-64

7.1.1.2.2.3 The extended inlet tube adapters were removed from the propellant valves following the vibration tests and the basic inlet tube adapters installed on the TCA. YES (Yes or No)

7.1.1.2.2.4 Inspection Remarks

8/27/64 PARA 7.1.1.2.2.2 PERFORMED PER ENGINEERING INSTRUCT-
ION PER IL 4388-5100. PK 99-K6644 & 9910695 TUBE INLET
ADAPTERS HAVE NO BP CR INSPECTION VERIFICATION

PREPARED BY <u>E. Adams</u>	DATE <u>8/27/64</u>	PERFORMED BY <u>P.F. (Civ.) - V. H. H.</u>	DATE <u>8/27/64</u>	WITNESSED FOR NAA <u>A. J. (Civ.) - H. H. H.</u>	DATE <u>8/27/64</u>	CERTIFIED FOR McDONNELL <u>A. D. Barroeno</u>	DATE <u>12/16/64</u>
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION:: TEST NO. 208160 SHEET 46 OF 380

7.1.3.2.3 Weight Determination Test Data (reference paragraph 6.6)

All protective closures were removed from the TCA.

YES (Yes or No)

The TCA dry weight was 3.18 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

NONE 9-9-64

PREPARED BY <u>E. Adams</u> DATE <u>4-10-64</u>	PERFORMED BY <u>W. L. Fowler</u> DATE <u>9-9-64</u>	WITNESSED FOR NAA <u>L. Johnson</u> DATE <u>9-9-64</u>	CERTIFIED FOR McDONNELL <u>A. D. Williams</u> DATE <u>9/23/64</u>
VERIFIED BY USAF <u>[Signature]</u>			DATE <u>9/23/64</u>

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DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 47 OF 380

- REFERENCE: M.G. SCD 52-52701, Revision F, Paragraph 6.2.3.17.3
- 7.1.2 Vibration - TCA #1
- 7.1.2.1 Test Procedure
- 7.1.2.1.1 Install the TCA into the vibration test facility. The direction of the vibration input shall be along the X axis of the TCA (see Figure 7).
NOTE: Remove nameplate and mount accelerometer. Replace nameplate at new location on TCA.
- 7.1.2.1.2 Perform a sine wave survey on the thrust chamber.
- 7.1.2.1.2.1 The survey shall be a one (1) G maximum peak logarithmic sweep from 5 to 2000 cps in 5 \pm 1 minutes.
- 7.1.2.1.2.2 Record the input and output accelerations on an oscillograph recorder.
- 7.1.2.1.3 Perform a ten (10) second vibration table equalization run at the test level to verify spectrum shape and tolerance.
- 7.1.2.1.3.1 Record and analyze the data.
- 7.1.2.1.3.2 The random vibration input shall be per Figure 8.
- 7.1.2.1.3.3 The power spectral density is to be the specified value with a plus forty (40) percent and minus thirty (30) percent tolerance when analyzed with 1/3 - octave or narrower filters.

PREPARED BY: J. Ganger	DATE 8-1-64	APPROVED FOR NAA: <i>R. Eide</i>	DATE 8-13-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>J. Ganger</i>	DATE 8-13-64				

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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-701 SHEET 48 OF 380

- 7.1.2.1.3.4 The overall RMS acceleration level is to be 7.5 G's, plus fifteen (15) percent, minus zero (0) percent.
- 7.1.2.1.3.5 No smaller than three (3) sigma clippers shall be used to limit the input level.
- 7.1.2.1.4 Readjust the controls and repeat paragraphs 7.1.2.1.3 and 7.1.2.1.3.1 as required to conform to paragraphs 7.1.2.1.3.2 through 7.1.2.1.3.4.
- 7.1.2.1.4.1 Test level equalization time for the purpose of verifying the spectrum shape shall not exceed twenty (20) percent of total test duration for each individual axis.
- 7.1.2.1.5 Vibrate the TCA with the random vibration input established in paragraph 7.1.2.1.4 for a duration of eight (8) ± 0.1 minutes less the time accumulated, for each respective axis, in paragraphs 7.1.2.1.3 and 7.1.2.1.4.
- 7.1.2.1.5.1 Record and analyze the input and output accelerations at selected intervals.
- 7.1.2.1.6 Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.5.1 except that the direction of vibration input shall be along the Y axis (see Figure 7.)
- 7.1.2.1.7 Repeat paragraphs 7.1.2.1.1 through 7.1.2.1.5.1 except that the direction of vibration input shall be along the Z axis (see Figure 7.)
- 7.1.2.1.8 Remove the TCA from the test setup.
- 7.1.2.1.9 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

PREPARED BY: J. Ganger	DATE 7-9-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE	<i>[Signature]</i> 8-4-64		<i>[Signature]</i>	

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 49 OF 380

- 7.1.2.1.10 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.
- 7.1.2.1.11 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.
- 7.1.2.1.12 Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.
- 7.1.2.1.13 Perform Propellant Valve Functional Test per paragraph 6.5.
- 7.1.2.1.14 Remove the extended inlet tube adapters and install the basic inlet tube adapters per paragraph 7.1.1.1.7.
- 7.1.2.1.15 Perform Weight Determination per paragraph 7.1.1.1.8.

PREPARED BY: J. Ganger	DATE 7-9-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 8-4-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 8-3-64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25% PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160 SHEET 50 OF 380

7.1.2.2 Test Data - TCA #1

7.1.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058233

7.1.2.2.2 Accelerometer Identification (Reference Figure 7)

Location	Sensitive Axis	Identification No.
TCA Input	X	S/N 113 (MIR 59)
TCA Input	Y	S/N 113
TCA Input	Z	S/N 113
Valve Bracket	X	S/N 1030
Valve Bracket	Y	S/N 1327 (MIR 59)
TCA Shell at Comb. Zone	X	S/N 1090 (MIR 59)
TCA Shell at Comb. Zone	Y	S/N 1127
TCA Shell at Comb. Zone	Z	S/N 1119
TCA Shell at Exit	X	S/N 903
TCA Shell at Exit	Y	S/N 1005
TCA Shell at Exit	Z	S/N 944 (MIR 59)

PREPARED BY <u>T.G. Kniffin</u> 7-9-64	DATE <u>9-2-64</u>	PERFORMED BY <u>[Signature]</u> DATE <u>9-2-64</u>	WITNESSED FOR NAA <u>[Signature]</u> DATE <u>9-2-64</u>	CERTIFIED FOR McDONNELL <u>J.D. Marogenis</u> DATE <u>9/23/64</u>
VERIFIED BY USAF <u>3</u>				DATE <u>9-2-64</u>

FORM 608-B-39 NEW 6-63

REVISION A J.D. Marogenis Dated 8-31-64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 203160-61
NAME OF TEST VIBRATION TEST NO. 203160-401 SHEET 52 OF 380

7.1.2.2.3.3

Random Vibration Test - X Axis

Accelerometer outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 \pm 0.5 Minute) 1 min
SAMPLE #2 (4 \pm 0.5 Minutes) 4 min
SAMPLE #3 (7 \pm 0.5 Minutes) 7.3 min

The elapsed time at test cutoff was 7.66 minutes.

Results of the Analysis:

SAMPLE #1 see 4M20-5-30
X axis shaped 60 to 65 seconds

SAMPLE #2 see 4M20-5-30
X axis shaped 240 to 245 seconds

SAMPLE #3 see 4M20-5-30
X axis shaped 440 to 445 seconds

PREPARED BY T.G. Kniffin 7-9-64	DATE 7-9-64	PERFORMED BY W. J. Sullivan 9-17-64	DATE 9-17-64	WITNESSED FOR NAA W. J. Sullivan 9-17-64	DATE 9-17-64	CERTIFIED FOR McDONNELL J. D. Mawgenis 9/22/64	DATE 9/22/64
VERIFIED BY USAF W. J. Sullivan 9-17-64						DATE 9/17/64	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 254 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 53 OF 380

7.1.2.2.3.4 Resonant Survey - Y Axis

Freq. cps	Input g's	Output g's	Identification (no)
265	1.0	6.0	903
310	1.0	5.0	1119
360	1.0	11.5	1430
450	1.0	16.0	1430
630	1.0	3.4	944
1300	1.0	3.2	944
1510	1.0	2.4	1127
1700	1.0	3.8	1430

7.1.2.2.3.5 Vibration Table Equalization Test - Y Axis

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	NO	4.0	40 SEC	40 SEC
2	NO	8.0	0 SEC	50 SEC
3	NES	8.0	0 SEC	60 SEC

PREPARED BY T.G. Kniffin 7-9-64	DATE 7/8/64	PERFORMED BY <i>P.C. Clark</i>	DATE 9/8/64	WITNESSED FOR NAA <i>ell. J. Jorgensen</i> 9/8/64	DATE 9/8/64	CERTIFIED FOR McDONNELL <i>L.D. Harrozenis</i> 9/27/64	DATE 9-1-65
VERIFIED BY USAF						DATE	

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61-
NAME OF TEST VIBRATION TEST NO. 208160-701 SHEET 54 OF 380

7.1.2.2.3.6 Random Vibration Test - Y Axis

Accelerometer outputs were recorded for analysis at the following elapsed times:

SAMPLE #1 (1 \pm 0.5 Minute) 1 Min
SAMPLE #2 (4 \pm 0.5 Minutes) 4 Min
SAMPLE #3 (7 \pm 0.5 Minutes) 6.75 Min

9-4-64 The elapsed time at test cutoff was 7.0 minutes. (MS 639) W

Results of the Analysis:

SAMPLE #1 See 4M20-5-30 Y Axis
shaped 60 to 65 second slice
time

SAMPLE #2 See 4M20-5-30 Y Axis
shaped 240 to 245 second slice
time

SAMPLE #3 See 4M20-5-30 Y Axis
shaped 405 to 410 second slice
time

PREPARED BY T.G. Kniffin 7-9-64	DATE 7-11-64	PERFORMED BY <i>P.C. Hook</i>	DATE 7-11-64	WITNESSED FOR NAA <i>R. Hughes</i>	DATE 7-11-64	CERTIFIED FOR McDONNELL <i>H.D. Brown</i>	DATE 7/17/64
						VERIFIED BY USAF	DATE 7/17/64

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 257 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-701 SHEET 55 OF 380

Freq. cps	Input g's	Output g's	Identification (no.)
43	1.0	3.0	5/N 1119
122	1.0	20.0	5/N 944
250	1.0	3.0	5/N 944
287	1.0	2.2	5/N 903
543	1.0	5.8	5/N 944

Test No	Satisfactory Spectrum Shape	Satisfactory RMS G Level	Test Duration	Accumulated Duration
1	YES	7.8	55 sec.	55 sec.

PREPARED BY T.G. Kniffin 7-9-64	DATE 9-5-64	PERFORMED BY J.P. Hall	DATE 9-11-64	WITNESSED FOR NAA B. Ray	DATE 9-22-64	CERTIFIED FOR McDONNELL J.D. Brown	DATE 9-23-64	VERIFIED BY USAF W. G. ...	DATE 9-11-64
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FORM 608-B-39 NEW 6-63.

Rev. M. P. Milward Date 12-16-64 * REF. DCP #1 7-5-64




ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 203160-61
NAME OF TEST VIBRATION TEST NO. 203160-401 SHEET 56 OF 380


7.1.2.2.3.9 Random Vibration Test-Z Axis


Acceleration outputs were recorded for analysis at the following elapsed times:


SAMPLE #1 (1 \pm 0.5 Minute) 1 MIN 
SAMPLE #2 (4 \pm 0.5 Minutes) 4 MIN 
SAMPLE #3 (7 \pm 0.5 Minutes) 6.75 MIN 

The elapsed time at test cutoff was 7.1 minutes. 9-5-64

Results of the Analysis:

SAMPLE #1 See 4M20-5-30 Z Axis
shaped 66 to 65 second slice
time 

SAMPLE #2 See 4M20-5-30 Z Axis
shaped 240-245 second slice
time 

SAMPLE #3 See 4M20-5-30 Z Axis
shaped 405 to 410 second slice
time 

PREPARED BY T.G. Kniffin 7-9-64	DATE 7-9-64	PERFORMED BY P.O. Noah 7-11-64	DATE 7-11-64	WITNESSED FOR NAA G. Faye 7-11-64	DATE 7-11-64	CERTIFIED FOR McDOONELL J.D. Harvath 9/27/64	DATE 9/27/64
						VERIFIED BY USAF W.D. Harvath 9/11/64	DATE 9/11/64

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 203160-401 SHEET 57 OF 380

7.1.2.2.3.10 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 \pm 10)	<u>500</u> psig	<u>500</u> psig
Time Duration (3 minimum)	<u>3</u> minutes	<u>3</u> minutes
Leakage Voltage (26 \pm 0.5) VDC	<u>26</u> VDC	<u>26</u> VDC
Inlet Pressure (500 \pm 10)	<u>500</u> psig	<u>500</u> psig
Time Duration (5 minimum)	<u>5</u> minutes	<u>5</u> minutes
Leakage Rate (2.23 maximum)	<u>ZERO</u> SCC He min	<u>ZERO</u> SCC He min
Inspection Remarks	<u>NO LE</u>	

PREPARED BY <u>E. Adams</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>Free</u>	DATE <u>9/8/64</u>	WITNESSED FOR NAA <u>[Signature]</u>	DATE <u>9/8/64</u>	CERTIFIED FOR McDONNELL <u>[Signature]</u>	DATE <u>9/22/64</u>
				VERIFIED BY USAF <u>[Signature]</u>	DATE <u>9/8/64</u>		

FORM 608-B-39 NEW 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 53 OF 380

7.1.2.2.3.11 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure

Pressure 392 psig (392 \pm 10) 1st Application 2nd Application

Time Duration 3.0 minutes (3 \pm 0.25) 3.0 minutes

Voltage (12 \pm 2.0) 12.0 VDC 12.0 VDC

Inspection Remarks NONE

PREPARED BY <u>E. Adams</u>	DATE <u>1/14/64</u>	PERFORMED BY <u>Sheller</u>	DATE <u>9/6/64</u>	WITNESSED FOR NAA <u>B. R. Young</u>	DATE <u>9/6/64</u>	CERTIFIED FOR McDONNELL <u>L. T. Harrison</u>	DATE <u>9/12/64</u>
				VERIFIED BY USAF <u>B. L. McElroy</u>		DATE <u>9/12/64</u>	

FORM 608-B-39 NEW 6-63

R-15019-2

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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 59 OF 380

7.1.2.2.3.12 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70° (70±10F)

Resistance A - B

Oxidizer Valve 41.4 ohms (Acceptable per Figure 9, yes or no yes)

Fuel Valve 42.5 ohms (Acceptable per Figure 9, yes or no yes)

Resistance C - D
(1.0 maximum)

Oxidizer Valve .05 ohms

Fuel Valve .76 ohms

Inspection Remarks None

PREPARED BY <u>E. Adams</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>C. J. Kudzia</u>	DATE <u>7-8-64</u>	WITNESSED FOR NAA <u>[Signature]</u>	DATE <u>9/8/64</u>	CERTIFIED FOR McDONNELL <u>A. D. Marozonis</u>	DATE <u>9/22/64</u>
						VERIFIED BY USAF <u>[Signature]</u>	DATE <u>1/18/68</u>

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 60 OF 380

7.1.2.2.3.13 Propellant Valve Dielectric Strength test (reference para. 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 ± 10 0	Current Microamps 500 max.	Voltage Volts 500 ± 10 0	Current Microamps 500 max.
A to Ground	500	78	500	80
C to Ground	500	58	500	60
A to C	500	26	500	25

Inspection Remarks

None

PREPARED BY <u>E. Adams</u> <u>24</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>C. S. Kudger</u> <u>9-8-64</u>	DATE <u>4/10/64</u>	WITNESSED FOR NAA <u>[Signature]</u> <u>10</u>	DATE <u>4/10/64</u>	CERTIFIED FOR McDONNELL <u>A. D. S. [Signature]</u> <u>7/22/64</u>	DATE <u>7/22/64</u>
				VERIFIED BY USAF <u>[Signature]</u> <u>1/28/64</u>		DATE <u>1/28/64</u>	

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION TEST NO. 208160-401 SHEET 61 OF 380

7.1.2.2.3.14 Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve Fuel Valve

Response Time

Ambient Temperature (70 ±10)	<u>70</u> F	<u>70</u> F
Energizing Voltage (26 ±0.5)	<u>26</u> VDC	<u>26</u> VDC
Inlet Pressure (300 ±10 for "pull-in")	<u>300</u> psig	<u>300</u> psig
Opening Time (0.0065 maximum)	<u>.0037</u> seconds	<u>.0039</u> seconds
Inlet Pressure (zero for "drop-out")	<u>zero</u> psig	<u>zero</u> psig
Closing Time (0.0035 maximum)	<u>.0025</u> seconds	<u>.0028</u> seconds

Low Voltage Operation

Ambient Temperature (70 ±10)	<u>70</u> F	<u>70</u> F
Inlet Pressure (300 ±10 for "pull-in")	<u>300</u> psig	<u>300</u> psig
Opening Voltage (16 maximum)	<u>8</u> VDC	<u>7</u> VDC
Inlet Pressure (zero for "drop-out")	<u>zero</u> psig	<u>zero</u> psig
Closing Voltage (1.0 minimum)	<u>2.0</u> VDC	<u>1.2</u> VDC

Inspection Remarks None

PREPARED BY <u>B. Adams</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>F. E. Dape</u>	DATE <u>7-8-64</u>	WITNESSED FOR NAA <u>J. F. Murphree</u>	DATE <u>9/1/64</u>	CERTIFIED FOR McDONNELL <u>D. Marrogens</u>	DATE <u>9/22/64</u>
				VERIFIED BY USAF <u>L. J. [unclear]</u>		DATE <u>9/25/64</u>	

FORM 608-B-39 NEW 6-63

ROCKETDYNE


DEVELOPMENT LABORATORY TEST REPORT

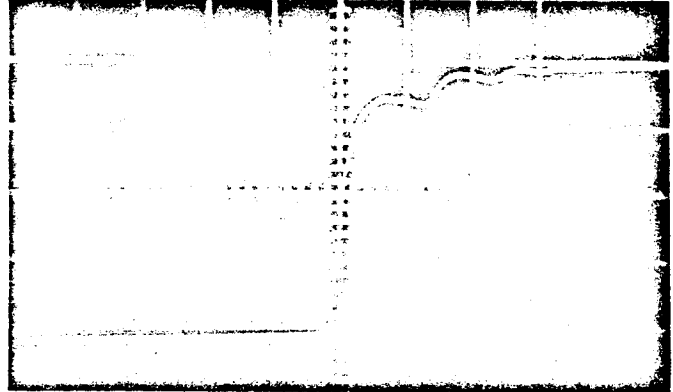
PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV. LAB	PHONE 2061	DATE 9-8-64
PART SE7 25# TCA Unit #1	PART NO. 208160-61 S/N 4058233	TYPE OF TEST Post Vibration Propellant Valve Functional		

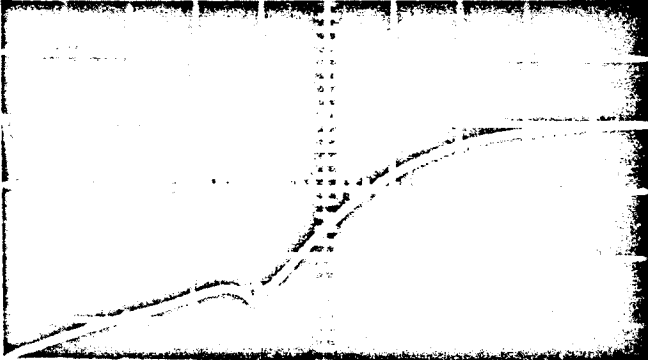
OXIDIZER VALVE	
P/N 407559	S/N 9193579


CURRENT TRACE (OPENING TIME)	
Horizontal = 1 ms/cm	
Vertical = 20 mv/cm	
Requirement = 0.0065 sec/max	
Actual = 0.0037 sec	

VOLTAGE TRACE (CLOSING TIME)	
Horizontal = 0.5 ms/cm	
Vertical = 10 v/cm	
Requirement = 0.0035 sec/max	
Actual = 0.0025 sec	

PREPARED BY F.Pope	EWR NO. 595396	FACILITY ENV.LAB.	PHONE 2061	DATE 9-8-64
PART SE7 25# TCA Unit #1	PART NO. 208160-61 S/N 4058233	TYPE OF TEST POST VIBRATION PROPELLANT VALVE FUNCTIONAL		

FUEL VALVE	
P/N 407560	S/N 4059525

CURRENT TRACE (OPENING TIME)	
Horizontal = 1 ms/cm	
Vertical = 20mv/cm	
Requirement - 0.0065 sec/max Actual = 0.0039 sec	

VOLTAGE TRACE (CLOSING TIME)	
Horizontal = 0.0035 sec/max	
Actual = 0.0028 sec	

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-401 SHEET 62 OF 380

- Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.3.16
- 7.1.3 Shock - TCA #1
- 7.1.3.1 Test Procedure
- 7.1.3.1.1 Place the TCA into shipping container in accordance with RAO616-008 and install in shock testing facility. The direction of shock input shall be along the + X Axis of the TCA (see Figure 7.)
- 7.1.3.1.2 Apply a half sine wave shock of 15 ± 1.5 g magnitude and 11 ± 1.0 milliseconds duration to the TCA. The shock magnitude and duration shall be monitored by an oscilloscope and the trace recorded with a Polaroid camera. Inspect the TCA for visible evidence of damage following the application of the shock. In the event of a structural failure see paragraph 3.6.
- 7.1.3.1.3 Repeat paragraph 7.1.3.1.2 two times for a total of three shocks.
- 7.1.3.1.4 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.3 for the - X Axis of the TCA.
- 7.1.3.1.5 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.4 for the Y Axis of the TCA.
- 7.1.3.1.6 Repeat paragraphs 7.1.3.1.1 through 7.1.3.1.4 for the Z Axis of the TCA.
- 7.1.3.1.7 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.
- 7.1.3.1.8 Perform Thrust Chamber Proof Pressure and Leakage per paragraph 6.2.

PREPARED BY: E. Adams DATE 4/10/64

APPROVED FOR NAA: DATE

APPROVED FOR McDONNELL: DATE

CHECKED BY: W. H. Adams DATE 4-12-64

R. V. Heide 4-13-64

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-401 SHEET 63 OF 380

- 7.1.3.1.9 Perform Propellant Valve Electrical Resistance per paragraph 6.3.
- 7.1.3.1.10 Perform Propellant Valve Dielectric Strength per paragraph 6.4.
- 7.1.3.1.11 Perform Propellant Valve Functional per paragraph 6.5.

PREPARED BY: <u>E. Adams</u> <u>4/10/64</u>	DATE	APPROVED FOR NAA: <u>Ry Heide</u> <u>4-13-64</u>	DATE	APPROVED FOR McDONNELL: <u>X</u>	DATE
CHECKED BY: <u>W. J. Hadden</u> <u>4-10-64</u>	DATE				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-61 SHEET 64 OF 380

7.1.3.2 Test Data - TCA #1

7.1.3.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058233

7.1.3.2.2 Shock Test (reference paragraph 7.1.3.1)

Magnitude 15 \pm 1.5 g's		Duration 11 \pm 1.0 milliseconds	
+ X Axis			
14.5		10 MS	
14.		10 MS	
14.		10 MS	
- X Axis			
14.		10 MS	
14.8		10 MS	
14.8		10 MS	

























PREPARED BY <u>E. Adams</u> <u>SA</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>J. O. Cook</u> <u>9-10-64</u>	DATE <u>9-10-64</u>	WITNESSED FOR NAA <u>J. H. Morrison</u> <u>9/10/64</u>	DATE <u>9/10/64</u>	CERTIFIED FOR McDONNELL <u>A. D. Morrison</u> <u>9/10/64</u>	DATE <u>9/10/64</u>
				VERIFIED BY USAF <u>A. D. Morrison</u> <u>9/10/64</u>			

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-101 SHEET 65 OF 380

7.1.3.2.2 Shock Test (reference paragraph 7.1.3.1)
(continued)

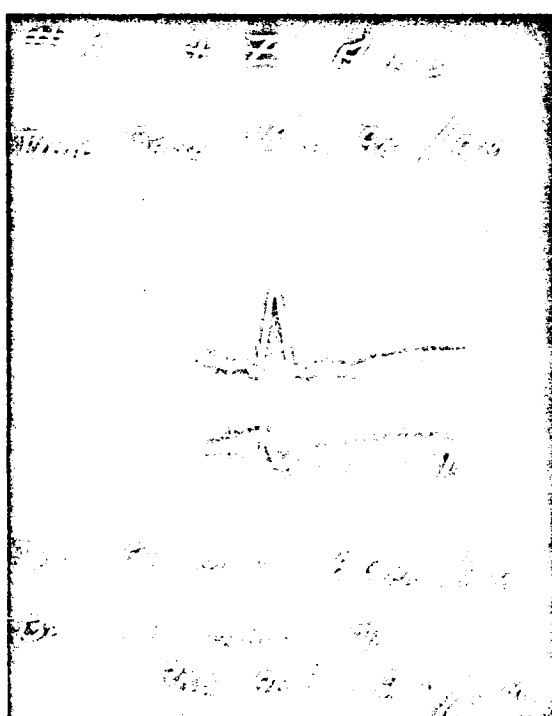
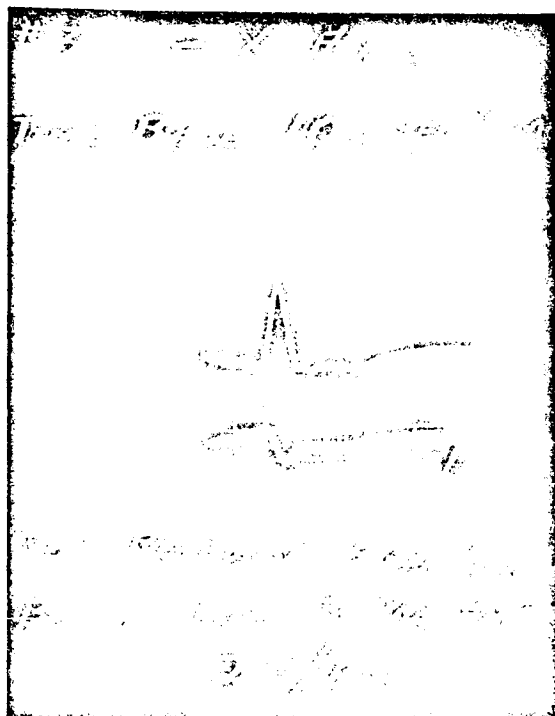
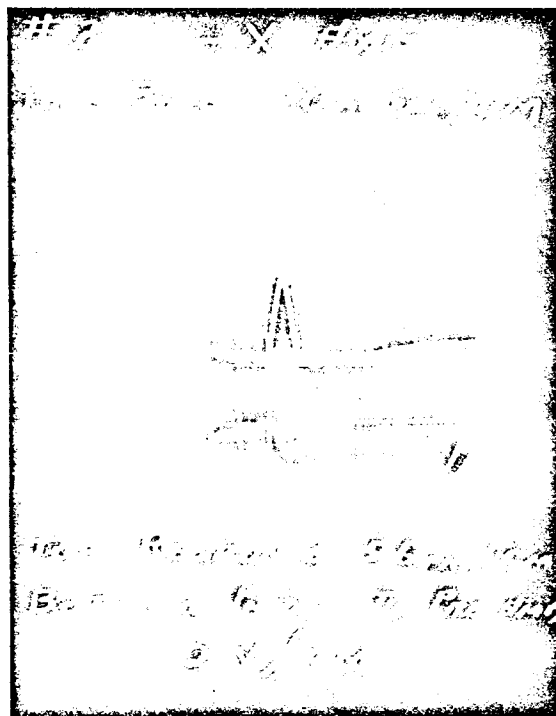
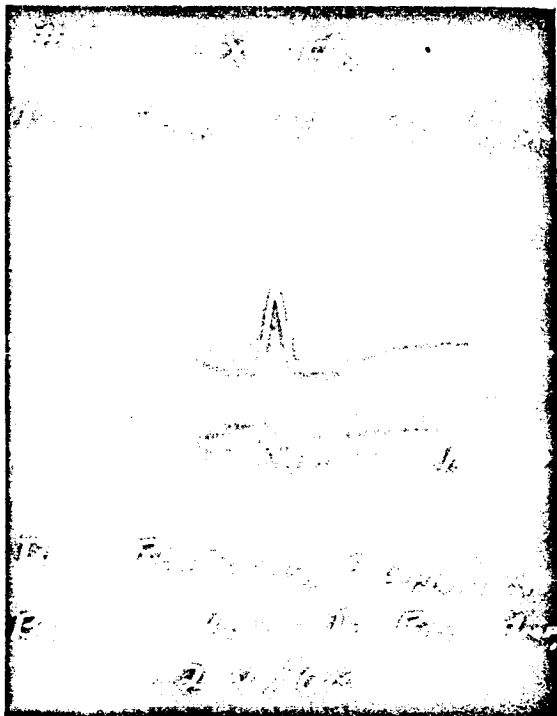
Magnitude 15 \pm 1.5 g's	Duration 11 \pm 1.0 milliseconds	Magnitude 15 \pm 1.5 g's	Duration 11 \pm 1.0 milliseconds
+ Y Axis		+ Z Axis	
 15	 10 ms	 15	 10 ms
 15	 10 ms	 14.5	 10 ms
 15	 10 ms	 15	 10 ms
- Y Axis		- Z Axis	
 14.5	 10 ms	 15	 10 ms
 15	 10 ms	 15	 10 ms
 15	 10 ms	 15	 10 ms

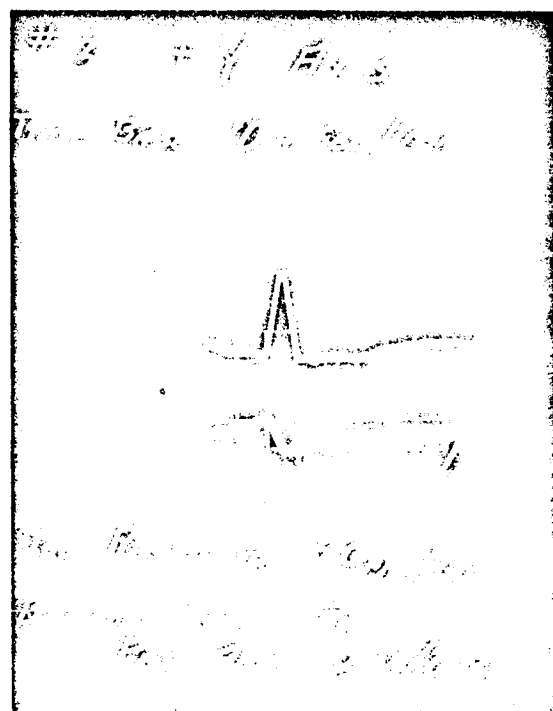
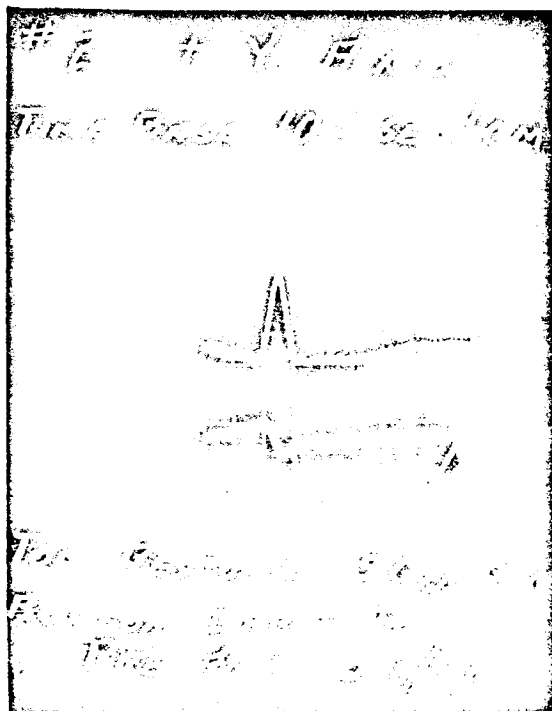
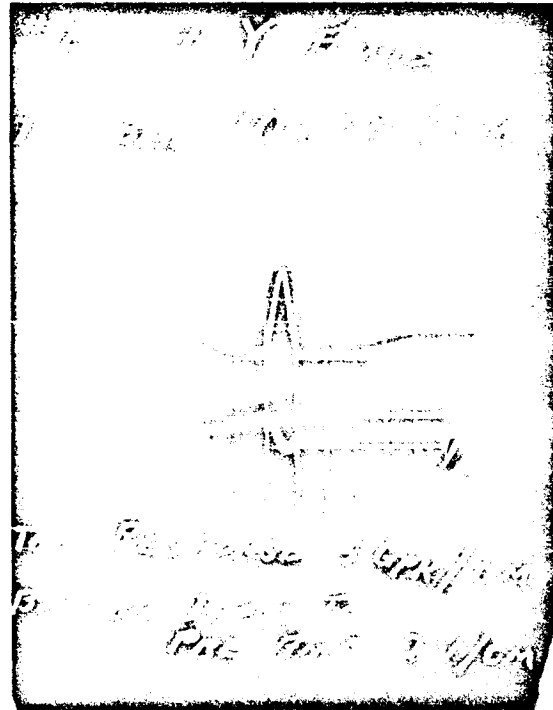
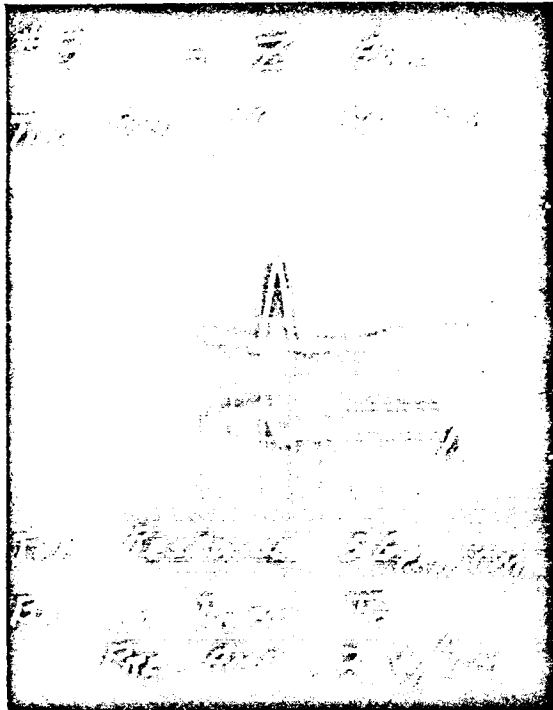
Inspection Remarks None 

PREPARED BY <u>E. Adams</u>	DATE <u>9/10/64</u>	PERFORMED BY <u>P. G. Koch</u>	DATE <u>9-10-64</u>	WITNESSED FOR NAA <u>[Signature]</u>	DATE <u>9-10-64</u>	CERTIFIED FOR McDONNELL <u>J. D. Harrison</u>	DATE <u>9/22/64</u>
						VERIFIED BY USAF <u>[Signature]</u>	DATE <u>9/10/64</u>

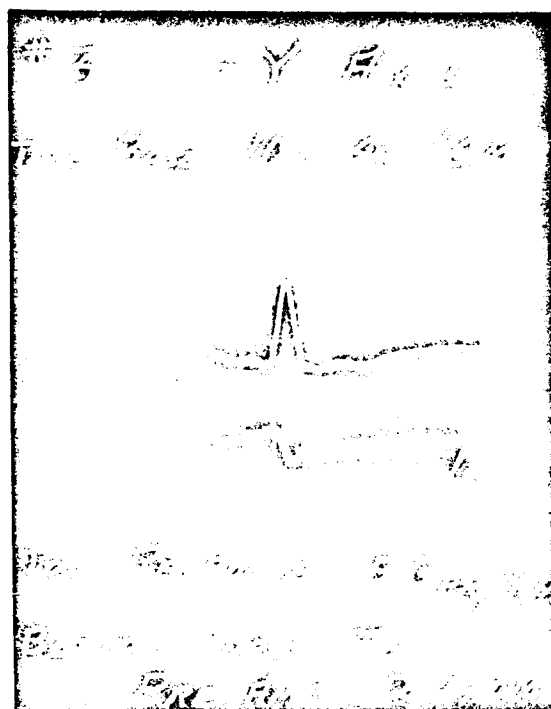
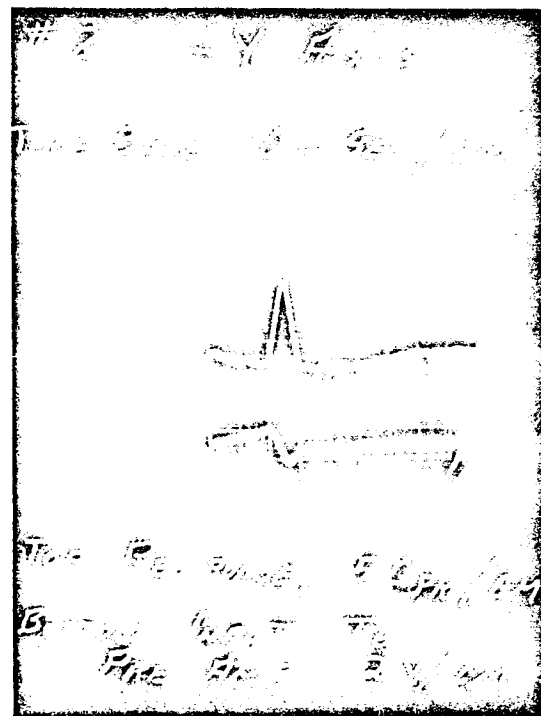
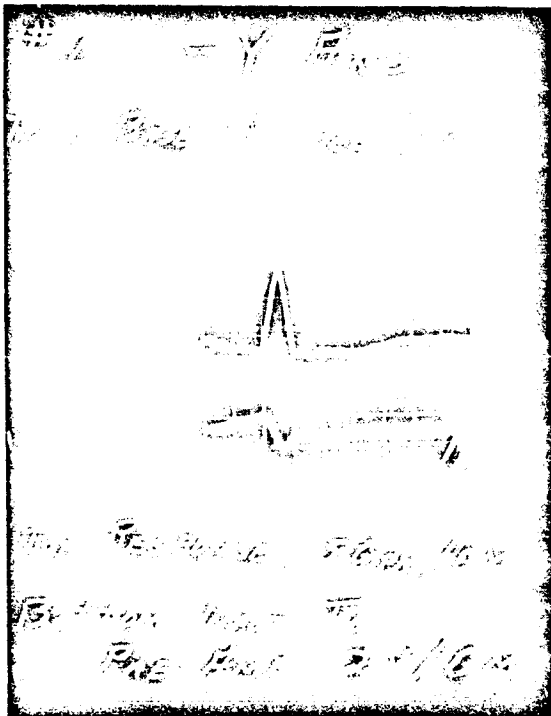
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DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-401 SHEET 66 OF 380

7.1.3.2.3

Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1.)

Oxidizer Valve

Fuel Valve

Proof Pressure

Pressure
(500 \pm 10)



570 psig



500 psig

Time Duration
(3 minimum)



3 minutes



3 minutes

Leakage
Voltage (26 \pm 0.5)
Inlet Pressure
(500 \pm 10)



26 VDC



26 VDC



500 psig



500 psig

Time Duration
(5 minimum)



5 minutes



5 minutes

Leakage Rate
(2.23 maximum)



Zero SCC He
min



Zero SCC He
min

Inspection Remarks

None

PREPARED BY E. Adams <i>EA</i>	DATE <u>4/10/64</u> <u>3/25/64</u>	PERFORMED BY F. E. Pope <i>F. E. Pope</i>	DATE <u>7-10-64</u>	WITNESSED FOR NAA <i>[Signature]</i>	DATE <u>7/10/64</u>	CERTIFIED FOR McDONNELL A. D. Nowrasianis <i>A. D. Nowrasianis</i>	DATE <u>9/22/64</u>
				VERIFIED BY USAF <i>[Signature]</i>		DATE <u>9/11/64</u>	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52601-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 203160-401 SHEET 67 OF 380

7.1.3.2.4 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure

1st Application

2nd Application

Pressure
(392 \pm 10)

392 psig

392 psig

Time Duration
(3 \pm 0.25)

3 minutes

3 minutes

Voltage (12 \pm 2.0)

12 VDC

12 VDC

Inspection Remarks: NO EVIDENCE OF LEAKAGE

PREPARED BY E. Adams 4/10/64	DATE 4/10/64	PERFORMED BY F. Z. Pope 9-10-64	DATE 9-10-64	WITNESSED FOR NAA [Signature] 9/10/64	DATE 9/10/64	CERTIFIED FOR McDONNELL D. D. Harris 9/23/64	DATE 9/23/64
VERIFIED BY USAF [Signature]						DATE 9/10/64	

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-401 SHEET 68 OF 380

7.1.3.2.5

Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 \pm 10F)

Resistance

A - B

Oxidizer Valve

4.5 ohms (Acceptable per Figure 9,
yes or no Yes)

Fuel Valve

438 ohms (Acceptable per Figure 9,
yes or no Yes)

Resistance

C - D

(1.0 maximum)

Oxidizer Valve

.05 ohms

Fuel Valve

.11 ohms

Inspection Remarks

NONE

PREPARED BY E. Adams <u>EA</u>	DATE <u>11/10/64</u>	PERFORMED BY F. T. Page <u>9-10-64</u>	DATE <u>9-10-64</u>	WITNESSED FOR NAA <u>F. T. Page</u>	DATE <u>9-10-64</u>	CERTIFIED FOR McDONNELL <u>A. D. Harrington</u>	DATE <u>9/22/64</u>
						VERIFIED BY USAF <u>W. B. L. L. L.</u>	DATE <u>9/11/64</u>

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-601 SHEET 69 OF 380

7.1.3.2.6

Propellant Valve Dielectric Strength test (reference paragraph 6.4.)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 \pm 10	Current Microamps 500 max.	Voltage Volts 500 \pm 10	Current Microamps 500 max.
A to Ground	500	49	500	40
C to Ground	500	21	500	21
A to C	500	16	500	15

(Inspection Remarks) NONE

PREPARED BY <u>E. Adams</u> <u>ef</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>F. Z. Pope</u> <u>9.10.64</u>	DATE <u>9.10.64</u>	WITNESSED FOR NAA <u>J. F. [Signature]</u> <u>9.10.64</u>	DATE <u>9.10.64</u>	CERTIFIED FOR McDONNELL <u>L. D. Marozzini</u> <u>9.10.64</u>	DATE <u>9.10.64</u>
				VERIFIED BY UCAF <u>[Signature]</u> <u>9.10.64</u>			

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST MECHANICAL SHOCK TEST NO. 208160-401 SHEET 70 OF 380

7.1.3.2.7 Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve Fuel Valve

Response Time

Ambient Temperature
(70 ±10)

70 F

70 F

Energizing Voltage
(26 ±0.5)

26 VDC

26 VDC

Inlet Pressure
(300 ±10 for "pull-in")

300 psig

300 psig

Opening Time

.0038 seconds

.0040 seconds

(0.0065 maximum)

Inlet Pressure

Zero psig

Zero psig

(zero for "drop-out")

Closing Time

.0025 seconds

.0028 seconds

(0.0035 maximum)

Low Voltage Operation

Ambient Temperature
(70 ±10)

70 F

70 F

Inlet Pressure
(300 ±10 for "pull-in")

300 psig

300 psig

Opening Voltage
(16 maximum)

7.8 VDC

7.0 VDC

Inlet Pressure

Zero psig

Zero psig

(zero for "drop-out")

Closing Voltage

2 VDC

1.1 VDC

(1.0 minimum)

Inspection Remarks

None

PREPARED BY <u>E. Adams</u>	DATE <u>1/10/64</u>	PERFORMED BY <u>L. C. Page</u>	DATE <u>1/10/64</u>	WITNESSED FOR NAA <u>[Signature]</u>	DATE <u>1/10/64</u>	CERTIFIED FOR McDONNELL <u>[Signature]</u>	DATE <u>1/22/64</u>
				VERIFIED BY USAF <u>[Signature]</u>	DATE <u>1/11/64</u>		

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.LAB	PHONE 2061	DATE 9-10-64
PART SE7 25# TCA Unit #1	PART NO. 208160-61 S/N 4058233	TYPE OF TEST Post Shock Propellant Valve Functional		

OXIDIZER VALVE

P/N 407559

S/N 9193579

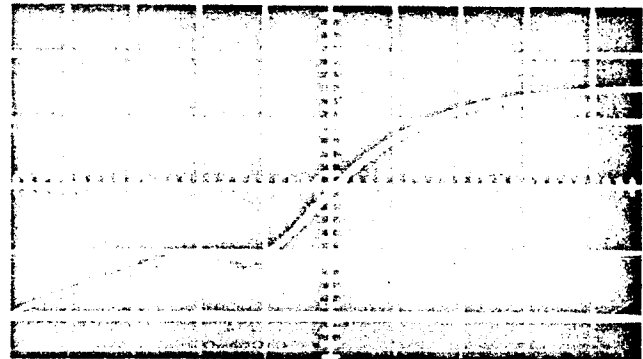
CURRENT TRACE
(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 20 mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0038 sec



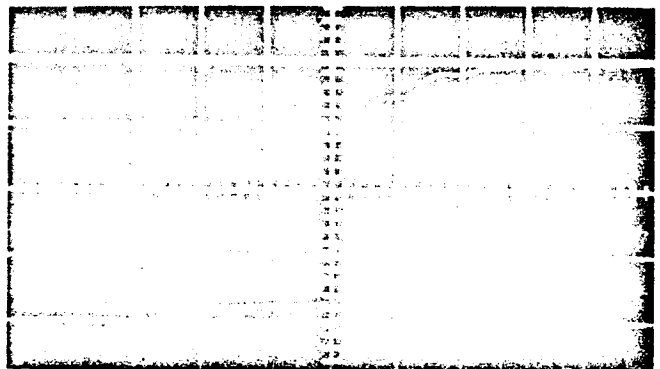
VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0025 sec



ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.TEST	PHONE 2061	DATE 9-10-64
PART SE7 25# TCA Unit #1	PART NO. 208160-61 S/N 4058233	TYPE OF TEST Post Shock Propellant Valve Functional		

FUEL VALVE

P/N 407560

S/N 4059525

CURRENT TRACE

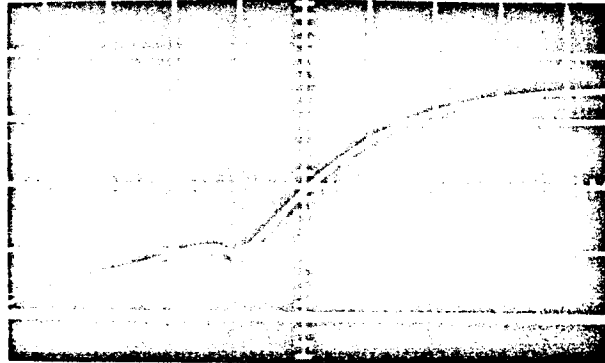
(OPENING TIME)

Horizontal = 1ms/cm

Vertical = 20mv/cm

Requirement = 0.0065 sec/mac

Actual = 0.0040 sec



VOLTAGE TRACE

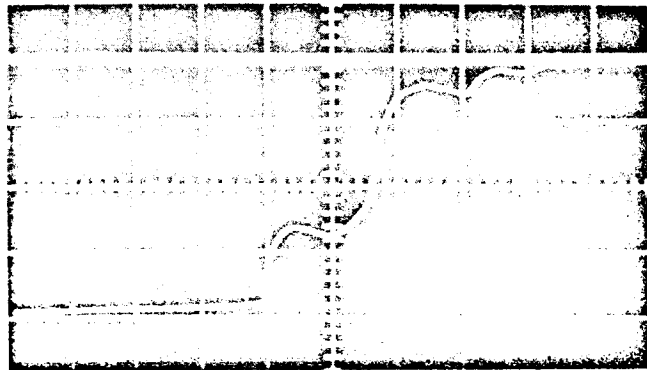
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10v/cm

Requirement = 0.0065 sec/max

Actual = 0.0028 sec



**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 71 OF 380

- Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.2.2
- 7.1.4 DAT Duty Cycle to Failure - TCA #1
- 7.1.4.1 Test Procedure
- 7.1.4.1.1 Perform Cape Cycle Firing Test per paragraph 6.7.
- 7.1.4.1.1.1 Make a one second firing followed by another one second firing ten minutes later.
- 7.1.4.1.1.2 Wait five minutes and make a one second firing followed by another one second firing ten minutes later.
- 7.1.4.1.1.3 Repeat paragraph 7.1.4.1.1.2.
- 7.1.4.1.2 Wait for TCA skin temperature to return to ambient temperature (70 ±20 F).
- 7.1.4.1.3 Perform Duty Cycle Firing Test per paragraph 6.7 and Table II. The TCA shall be fired until catastrophic failure occurs. Catastrophic failure is defined in Table II, note 4.
- 7.1.4.1.4 Perform decontamination per paragraph 6.8.
- 7.1.4.1.5 Reduce data per SEM 4388-4040.
- 7.1.4.1.5.1 The results of significant data shall include but not be limited to the following:
- 7.1.4.1.5.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations.
- 7.1.4.1.5.1.2 Graphical presentation of total impulse versus signal width:
- 7.1.4.1.5.1.3 Graphical presentation of mean specific impulse versus signal width:
- 7.1.4.1.5.1.4 Failure analysis.

PREPARED BY: D. Cole	DATE 9/29/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 9-29-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE				

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 72 OF 380

7.1.4.2 Test Data - TCA No. 1

7.1.4.2.1 Component Identification

Component Name SE-7 (ANG 930)

McDonnell Part No. 52-52701-265 (ANG 930)

Rocketdyne Part No. 208160-61 (ANG 930)

Component Serial No. 4058233 (ANG 930)

Accumulated Acceptance Test Firing Time, seconds 3.0 SEC.

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pre-Test	Post Test
3.576	3.575
2.229	2.230

7.1.4.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	4/10/64	4/10/64
Sample Batch Number	1-1	1-1
Sample Temperature, F	6	11
Sample Specific Gravity	1.4	1.370
Met Mil Spec. Requirements (Yes or No)		

PREPARED BY E. Adams 4/10/64	PERFORMED BY E. S. Hadden 10/10/64	WITNESSED FOR NAA J. G. Kelly (ANG 930)	CERTIFIED FOR McDONNELL D. J. Carrozzini 12/17/64 VERIFIED BY USAF 12/19/64
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FORM 608-B-39 NEW 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 72 OF 380

7.1.4.2.3 Cape Cycle Test (reference paragraph 7.1.4.1)

Test Cell Location CTL III

Test Cell Number 39-I

Test Number 089

Test Date 10-3-64

	Pulse Duration (sec) (1.000 \pm .020 sec)	Time between Pulses, (minutes)
1st Pulse	* <u>1.015 H35md</u>	<u>—</u>
2nd Pulse	<u>1.015</u>	<u>10</u> (10)
3rd Pulse	<u>1.016</u>	<u>5</u> (5)
4th Pulse	<u>1.015</u>	<u>10</u> (10)
5th Pulse	<u>1.015</u>	<u>5</u> (5)
6th Pulse	<u>1.014</u>	<u>10</u> (10)
Accumulated Firing Time, seconds <u>6.09</u>		

* Disc. Time lines unrendable

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
D. Cole	9/29/64	H. ROBINSON		<i>[Signature]</i>			
						VERIFIED BY USAF	DATE

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 73 OF 380

7.1.4.2.4 DAT Duty Cycle Data (reference paragraph 7.1.4.1)

Test Cell Location CTL III

Test Cell Number 39-J

Test Number 090

Test Date 10-3-64

NOTE: All data corrected to Standard Vacuum conditions.

PREPARED BY J. Ganger 9/29/64	DATE 9/29/64	PERFORMED BY E. S. Gribben 10/3/64	DATE 10/3/64	WITNESSED FOR NAA A. J. Kelly 11/1/64	DATE 11/1/64	CERTIFIED FOR McDONNELL L. D. Harrington 12/13/64	DATE 12/13/64
VERIFIED BY USAF						DATE 12/18/64	

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-SHEET 05

Sequence Number 1

Pulse Number	2	16	36
Signal Width, msec	22.6	25.9	30.6
Start Time, msec (25 max.)	13.9	8.9	15.8
Environmental Pressure, psia	.011	.011	.011
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	5409	5801	6925
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max) **	1915	1900	1932
Cut-Off Time, msec	12.4	16.6	13.4
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.636	.636	.636
Fuel Valve Current, amps	.623	.623	.623
Electrical Power, watts	32.7	32.7	32.7

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by:

J. J. Reardon

Checked by:

W. J. [Signature]

Approved for NAA by:

[Signature]

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 1 OF 1

Sequence Number <u>2</u>	Site Data	Standard Vacuum
Pulse Number <u>1</u>		
Firing Duration, sec	<u>4.2</u>	
Accumulated Firing Time, sec	<u>21.0</u>	
Data Slice Number	<u>1</u>	
Time of Data Slice, sec	<u>4.0</u>	
Environmental Pressure, psia	<u>0.11</u>	0
Environmental Temperature, °F	<u>91 (vac. chamber)</u>	
Oxidizer Temperature, °F	<u>84</u>	70
Fuel Temperature, °F	<u>84</u>	70
Oxidizer Inlet Pressure, psia	<u>290.7</u>	292
Fuel Inlet Pressure, psia	<u>290.5</u>	292
Oxidizer Flowrate, lbs/sec	<u>0.460</u>	<u>0.462</u>
Fuel Flowrate, lbs/sec	<u>0.354</u>	<u>0.357</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.30</u>	<u>1.30</u>
Thrust, lbs (23.0±5%)	<u>23.9</u>	<u>24.0</u>
Specific Impulse (272 min.)	<u>293</u>	<u>294</u>
Start Time, msec (25 max)	<u>15.</u>	
Shutdown Impulse, lb-sec (.260 max)**	<u>1680</u>	
Oxidizer Valve Voltage, volts	<u>28.9</u>	
Fuel Valve Voltage, volts	<u>29.1</u>	
Oxidizer Valve Current, amps	<u>6.64</u>	
Fuel Valve Current, amps	<u>6.44</u>	
Electrical Power, watts	<u>37.9</u>	

** Ref: ECN NA-SE6-289R1

Prepared by:

W. R. Anderson

Checked by:

W. R. Anderson

Approved for NAA by:

R. Heide

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 203160-101 SHEET 101 OF 101

	<u>Site Data</u>	<u>Standard Vacuum</u>
Sequence Number <u>3</u>		
Pulse Number <u>1</u>		
Firing Duration, sec	<u>.686</u>	
Accumulated Firing Time, sec	<u>21.9</u>	
Data Slice Number	<u>2</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.011</u>	0
Environmental Temperature, °F	<u>92 (VAC. chamber)</u>	
Oxidizer Temperature, °F	<u>84</u>	70
Fuel Temperature, °F	<u>84</u>	70
Oxidizer Inlet Pressure, psia	<u>290.7</u>	292
Fuel Inlet Pressure, psia	<u>287.9</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0462</u>	<u>.0464</u>
Fuel Flowrate, lbs/sec	<u>.0344</u>	<u>.0349</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.34</u>	<u>1.33</u>
Thrust, lbs (23.0±5%)	<u>23.6</u>	<u>23.9</u>
Specific Impulse	<u>293</u>	<u>294</u>
Start Time, msec (25 max)	<u>16.5</u>	
Shutdown Impulse, lb-sec (.260 max)**	<u>.2048</u>	
Oxidizer Valve Voltage, volts	<u>28.9</u>	
Fuel Valve Voltage, volts	<u>29.2</u>	
Oxidizer Valve Current, amps	<u>.661</u>	
Fuel Valve Current, amps	<u>.650</u>	
Electrical Power, watts	<u>38.1</u>	

** Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved by: NAA by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 1 OF 1

Sequence Number 4

Pulse Number	3	9	27
Signal Width, msec	17.8	19.6	17.4
Start Time, msec (25 max.)	17.1	17.1	15.8
Environmental Pressure, psia	.011	.011	.011
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	.3212	.3956	.3089
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max) **	.1791	.2091	.1772
Cut-Off Time, msec	15.4	16.1	13.5
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.636	.636	.636
Fuel Valve Current, amps	.623	.623	.623
Electrical Power, watts	32.7	32.7	32.7

* Flows Unreadable - Instrumentation Problems

** Ref: EGN-NA-SE6-289R1

Prepared by:

J. J. Robinson

Checked by:

W. J. [Signature]

Approved for NAA by:

[Signature]

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 101 OF 101

	<u>Site Data</u>	<u>Standard Vacuum</u>
Sequence Number <u>5</u>		
Pulse Number <u>3</u>		
Firing Duration, sec	<u>.702</u>	
Accumulated Firing Time, sec	<u>26.5</u>	
Data Slice Number	<u>3</u>	
Time of Data Slice, sec	<u>.165</u>	
Environmental Pressure, psia	<u>.011</u>	0
Environmental Temperature, °F	<u>85 (VHC. chamber)</u>	
Oxidizer Temperature, °F	<u>86</u>	70
Fuel Temperature, °F	<u>86</u>	70
Oxidizer Inlet Pressure, psia	<u>295.5</u>	292
Fuel Inlet Pressure, psia	<u>290.3</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0470</u>	<u>.0467</u>
Fuel Flowrate, lbs/sec	<u>.0353</u>	<u>.0357</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.33</u>	<u>1.31</u>
Thrust, lbs (23.0±5%)	<u>23.8</u>	<u>23.8</u>
Specific Impulse (112 in.)	<u>289</u>	<u>289</u>
Start Time, msec (25 max)	<u>14</u>	
Shutdown Impulse, lb-sec (.260 max) **	<u>.2186</u>	
Oxidizer Valve Voltage, volts	<u>29.0</u>	
Fuel Valve Voltage, volts	<u>29.2</u>	
Oxidizer Valve Current, amps	<u>.661</u>	
Fuel Valve Current, amps	<u>.647</u>	
Electrical Power, watts	<u>38.1</u>	

** Ref: ECN NA-SE6-289R1

Prepared by: <i>J. H. De la Cruz</i>	Checked by: <i>[Signature]</i>	Approved for NAA by: <i>[Signature]</i>
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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
 NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number 6

Pulse Number	2	15	27
Signal Width, msec	24.3	23.9	23.3
Start Time, msec (25 max.)	14.4	14.6	10.9
Environmental Pressure, psia	.011	.011	.011
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	.5189	.4958	.5065
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max) **	.2057	.2038	.2181
Cut-Off Time, msec	15.1	16.5	15.1
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.636	.636	.636
Fuel Valve Current, amps	.623	.623	.623
Electrical Power, watts	32.7	32.7	32.7

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by: <i>12/ Dehman</i>	Checked by: <i>W. J. Puckett</i>	Approved for by: <i>R. K. ...</i>
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FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 1 OF 1

Sequence Number 7

Pulse Number	15	101	
Signal Width, msec	36.8	36.9	
Start Time, msec (25 max.)	14.4	10.6	
Environmental Pressure, psia	.011	.011	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	1
Fuel Inlet Pressure, psia	292	292	2
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	8179	8421	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max) **	2015	2273	
Cut-Off Time, msec	16.6	15.0	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.636	.636	
Fuel Valve Current, amps	.623	.623	
Electrical Power, watts	32.7	32.7	

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by: <i>W. Robinson</i>	Checked by: <i>W. J. Robinson</i>	Approved for NA by: <i>R. J. Gledhill</i>
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FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>8</u>	Site Data	Standard Vacuum
Pulse Number <u>3</u>		
Firing Duration, sec	<u>.691</u>	
Accumulated Firing Time, sec	<u>36.0</u>	
Data Slice Number	<u>4</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.011</u>	0
Environmental Temperature, °F	<u>85</u> (vac. chamber)	
Oxidizer Temperature, °F	<u>87</u>	70
Fuel Temperature, °F	<u>87</u>	70
Oxidizer Inlet Pressure, psia	<u>290.7</u>	292
Fuel Inlet Pressure, psia	<u>290.3</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0474</u>	<u>.0477</u>
Fuel Flowrate, lbs/sec	<u>.0355</u>	<u>.0358</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.34</u>	<u>1.33</u>
Thrust, lbs (23.0±5%)	<u>23.6</u>	<u>23.8</u>
Specific Impulse (sec)	<u>285</u>	<u>286</u>
Start Time, msec (25 max)	<u>13.5</u>	
Shutdown Impulse, lb-sec (.260 max)**	<u>.1894</u>	
Oxidizer Valve Voltage, volts	<u>28.9</u>	
Fuel Valve Voltage, volts	<u>29.1</u>	
Oxidizer Valve Current, amps	<u>.666</u>	
Fuel Valve Current, amps	<u>.656</u>	
Electrical Power, watts	<u>38.3</u>	

** Ref: ECN NA-SE6-289R1

Prepared by:

11/22/63

Checked by:

[Signature]

Approved for NAA by:

[Signature]

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 1 OF 1

Sequence Number 9

Pulse Number	2	4	
Signal Width, msec	32.2	32.0	
Start Time, msec (25 max.)	14.1	13.7	
Environmental Pressure, psia	.011	.011	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	7
Fuel Inlet Pressure, psia	292	292	0
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	7222	7201	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max) **	2050	2034	
Cut-Off Time, msec	17.2	16.2	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.636	.636	
Fuel Valve Current, amps	.623	.623	
Electrical Power, watts	32.7	32.7	

* Flows Unreadable - Instrumentation Problems

* ** Ref: ECN NA-SE6-289R1

Prepared by:

191 DeLunnon

Checked by:

W. J. Richert

Approved for NAA by:

J. H. Reed

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number 10

Pulse Number	3	9	544
Signal Width, msec	58.5	58.8	58.4
Start Time, msec (25 max.)	12.9	12.6	13.2
Environmental Pressure, psia	.011	.011	.011
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	1.4303	1.4361	1.3983
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max) **	2093	2108	1931
Cut-Off Time, msec	16.4	14.4	16.3
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.636	.636	.636
Fuel Valve Current, amps	.623	.623	.623
Electrical Power, watts	32.7	32.7	32.7

* Flows Unreadable - Instrumentation Problems

** Ref: NA-SE6-289R1

Prepared by:

12/1/63 [Signature]

Checked by:

[Signature]

Approved for NAA by:

[Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 1 OF 1

Sequence Number 11

Pulse Number	<u>15</u>		
Signal Width, msec	<u>35.3</u>		
Start Time, msec (25 max.)	<u>14.2</u>		
Environmental Pressure, psia	<u>1011</u>		
Environmental Temperature, °F	<u>70</u>		
Oxidizer Inlet Temperature, °F	<u>70</u>		
Fuel Inlet Temperature, °F	<u>70</u>		
Oxidizer Inlet Pressure, psia	<u>292</u>	<u>7</u>	
Fuel Inlet Pressure, psia	<u>292</u>		
Total Oxidizer Flow, lbs	<u>*</u>		
Total Fuel Flow, lbs	<u>*</u>		
Mean Mixture Ratio, o/f	<u>*</u>		
Pulse Total Impulse, lb-sec	<u>8454</u>		
Mean Specific Impulse, sec	<u>*</u>		
Shutdown Impulse, lb-sec (.260 max) **	<u>2479</u>		
Cut-Off Time, msec	<u>18.3</u>		
Oxidizer Valve Voltage, volts	<u>26</u>		
Fuel Valve Voltage, volts	<u>26</u>		
Oxidizer Valve Current, amps	<u>.636</u>		
Fuel Valve Current, amps	<u>.623</u>		
Electrical Power, watts	<u>32.7</u>		

* Flows Unreadable - Instrumentation Problems

** Ref: NA-SE6-289R1

Prepared by:
W. Robinson

Checked by:
[Signature]

Approved for NAA by:
[Signature]

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25A PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET OF

Sequence Number <u>15</u>	Site Data	Standard Vacuum
Pulse Number <u>4</u>		
Firing Duration, sec	<u>.494</u>	
Accumulated Firing Time, sec	<u>77.1</u>	
Data Slice Number	<u>5</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.011</u>	0
Environmental Temperature, °F	<u>87</u>	(VAC. CHAMBER)
Oxidizer Temperature, °F	<u>90</u>	70
Fuel Temperature, °F	<u>90</u>	70
Oxidizer Inlet Pressure, psia	<u>290.7</u>	292
Fuel Inlet Pressure, psia	<u>292.6</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0470</u>	<u>.0473</u>
Fuel Flowrate, lbs/sec	<u>.0355</u>	<u>.0355</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.32</u>	<u>1.33</u>
Thrust, lbs (23.0±5%)	<u>23.6</u>	<u>23.7</u>
Specific Impulse (.....)	<u>286</u>	<u>286</u>
Start Time, msec (25 max)	<u>14.5</u>	
Shutdown Impulse, lb-sec (.260 max)**	<u>.2316</u>	
Oxidizer Valve Voltage, volts	<u>28.9</u>	
Fuel Valve Voltage, volts	<u>29.2</u>	
Oxidizer Valve Current, amps	<u>.658</u>	
Fuel Valve Current, amps	<u>.647</u>	
Electrical Power, watts	<u>37.9</u>	

** Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved for NAA by:

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 203160-401 SHEET 1 OF 1

Sequence Number 17

Pulse Number	<u>9</u>		
Signal Width, msec	<u>48.2</u>		
Start Time, msec (25 max.)	<u>14.0</u>		
Environmental Pressure, psia	<u>.011</u>		
Environmental Temperature, °F	<u>70</u>		
Oxidizer Inlet Temperature, °F	<u>70</u>		
Fuel Inlet Temperature, °F	<u>70</u>		
Oxidizer Inlet Pressure, psia	<u>292</u>	<u>7</u>	
Fuel Inlet Pressure, psia	<u>292</u>	<u>-</u>	
Total Oxidizer Flow, lbs	<u>*</u>		
Total Fuel Flow, lbs	<u>*</u>		
Mean Mixture Ratio, o/f	<u>*</u>		
Pulse Total Impulse, lb-sec	<u>1.1797</u>		
Mean Specific Impulse, sec	<u>*</u>		
Shutdown Impulse, lb-sec (.260 max) **	<u>2365</u>		
Cut-Off Time, msec	<u>23.2</u>		
Oxidizer Valve Voltage, volts	<u>26</u>		
Fuel Valve Voltage, volts	<u>26</u>		
Oxidizer Valve Current, amps	<u>.636</u>		
Fuel Valve Current, amps	<u>.623</u>		
Electrical Power, watts	<u>32.7</u>		

* Flows Unreadable - Instrumentation Recordings
** Ref: ECN NA-SE6-289R1

Prepared by:
W. L. Richardson

Checked by:
[Signature]

Approved for NAA by:
[Signature]

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>23</u>	Site Data	Standard Vacuum
Pulse Number <u>4</u>		
Firing Duration, sec	<u>.688</u>	
Accumulated Firing Time, sec	<u>117.9</u>	
Data Slice Number	<u>6</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.011</u>	0
Environmental Temperature, °F	<u>89 (VAC. chamber)</u>	
Oxidizer Temperature, °F	<u>90</u>	70
Fuel Temperature, °F	<u>90</u>	70
Oxidizer Inlet Pressure, psia	<u>295.5</u>	292
Fuel Inlet Pressure, psia	<u>292.6</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0464</u>	<u>.0462</u>
Fuel Flowrate, lbs/sec	<u>.0357</u>	<u>.0359</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.30</u>	<u>1.29</u>
Thrust, lbs (23.0±5%)	<u>23.7</u>	<u>23.7</u>
Specific Impulse (222 sec.)	<u>289</u>	<u>289</u>
Start Time, msec (25 max)	<u>13.5</u>	
Shutdown Impulse, lb-sec (.260 max)**	<u>.2293</u>	
Oxidizer Valve Voltage, volts	<u>29.1</u>	
Fuel Valve Voltage, volts	<u>29.3</u>	
Oxidizer Valve Current, amps	<u>.653</u>	
Fuel Valve Current, amps	<u>.641</u>	
Electrical Power, watts	<u>37.8</u>	

** Ref: ECN NA-SE6-289R1

Prepared by: 12/1/63 Checked by: [Signature] Approved for NAA by: [Signature]

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number 25

Pulse Number	2	6	
Signal Width, msec	51.6	51.7	
Start Time, msec (25 max.)	13.4	13.4	
Environmental Pressure, psia	.011	.011	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	7
Fuel Inlet Pressure, psia	292	292	0
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	1.2708	1.2931	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max) **	.2483	.2460	
Cut-Off Time, msec	.21.8	24.7	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.636	.636	
Fuel Valve Current, amps	.623	.623	
Electrical Power, watts	32.7	32.7	

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by:

J. H. Harrison

Checked by:

[Signature]

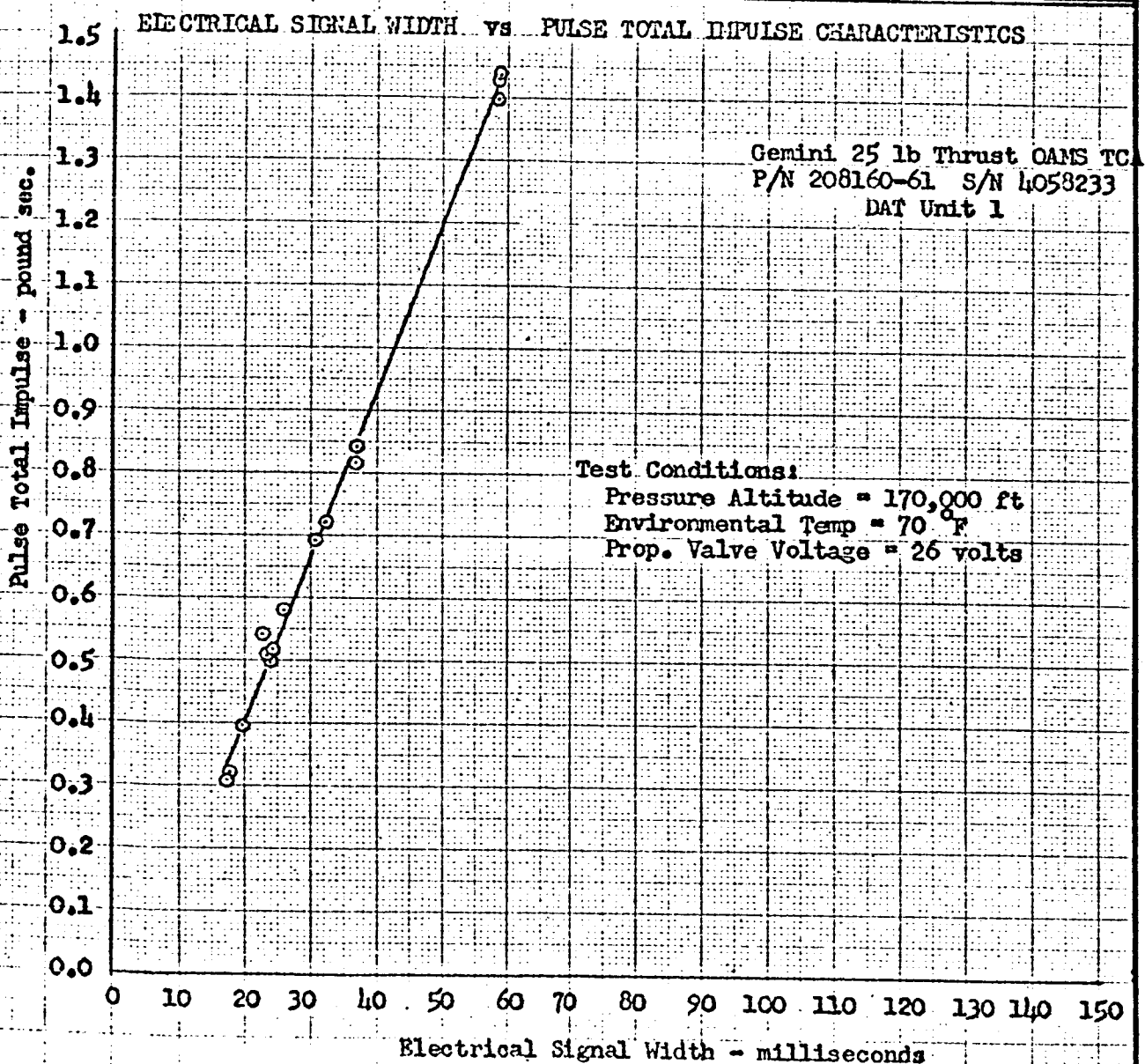
Approved for CIAA by:

[Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

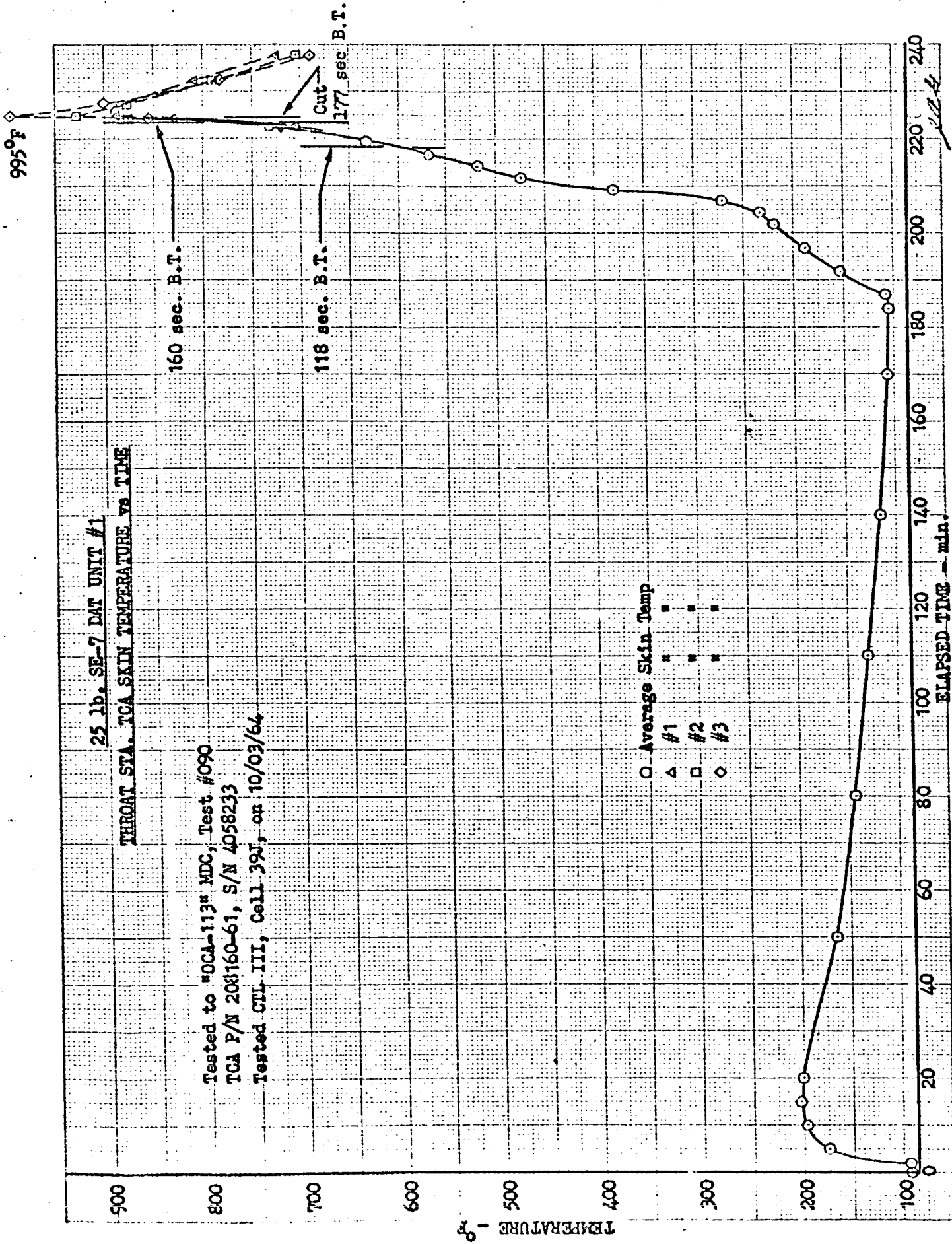
COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
TEST NO. DAT DUTY CYCLE TO FAILURE SHEET OF



FORM 608-B-40 NEW 6-63

25 lb. SE-7 DAT UNIT #1
THROAT STA. TCA SKIN TEMPERATURE vs TIME

Tested to "OCA-113" MDC, Test #090
TCA P/N 208160-61, S/N 4058233
Tested CTL III, Cell 39J, on 10/03/64



DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO FAILURE TEST NO. 208160-401 SHEET 87 OF 380

7.1.4.2.5. Failure Data

Accumulated Firing Time, sec. 177. (MDC)

Description of Failure Mode:

THE MDC TEST ON UNIT 1 WAS
TERMINATED AFTER 177 SECONDS
OF ACCUMULATED (MDC) BURN TIME.
THE MODE OF "FAILURE" WAS SHELL
TEMPERATURES IN EXCESS OF THE
SPECIFICATION MAXIMUM THAT
DEFINES THE TEST TO "FAILURE"

PREPARED BY E. Adams <i>Et</i>	DATE <u>4/10/64</u>	PERFORMED BY <u>HR</u>	DATE	WITNESSED FOR NAA <i>W A Pickett</i>	DATE	CERTIFIED FOR McDONNELL DATE
				VERIFIED BY USAF	DATE	

FORM 608-B-39 NEW 6-63

UNIT #1

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058233Dwg. No. 208160-61Model SE-7 OAMS

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY		
			Mech. & Date	Lead-man & Date	Insp. & Date
1	9/15/64 (ANR 224)	<p>CTH # Cell '39</p> <p>PART NO. PARA 7.1.2.2.3.8 SPECIFIES 'X' AXIS. SHOULD BE 'Z' AXIS</p>			
ACTION TAKEN		<p>Para 7.1.2.2.3.8 WAS RECD AS Z AXIS. L COLE 5961356 C/N 120 T-114</p>	(ANR 224)	(ANR 224)	
2	10/12/64 (ANR 930)	<p>PART NO. GENERAL: N.T.O. CHEM. ANALYSIS DOES NOT COMPLY WITH MIL-ST-26539A FOR WATER CONTENT.</p>			
ACTION TAKEN		<p>LATEST. CHEM. ANALYSIS ON N.T.O DOES COMPLY WITH MIL-P-26539A</p>	(ANR 930)	(ANR 930)	(ANR 930)
3	10/13/64 (ANR 930)	<p>PART NO. 208160-61 S/N 4058233 CAPE CYCLE FIRING NOT PERFORMED TO DAT SPEC. REF. PAR. 7.1.4.1.1.1.</p>			
ACTION TAKEN		<p>MAC 320-52-52701, REV. 2 SPECIFIES A FIVE, TEN, FIVE, TEN, FIVE MINUTE WAITS DURING CAPE CYCLE. THE DAT SPEC. REQUIRES TEN, FIVE, TEN, SEC. MINUTE WAIT. THE DAT SPEC. IS WRONG AND THE TEST WAS MADE TO COMPLY WITH THE MAC 320. J. A. B. 10-7-64</p>	(ANR 930)	(ANR 930)	(ANR 930)
4	10/13/64 (ANR 930)	<p>PART NO. General: HIF Test 089 F 090 Waived via Telecon B4 MAC B.C. MR. Michals</p>			
ACTION TAKEN		<p>INFORMATION ONLY</p>	(ANR 930)	(ANR 930)	(ANR 930)
5	10/13/64 (ANR 930)	<p>PART NO. 208160-61 S/N 4058233 T.C.H. Test # 090 Exceeded 550°F. Prior To Accumulating 118 sec Firing Time. Ref. Table II Note # 2</p>			
ACTION TAKEN		<p>TRANSFERRED TO SHORTAGE 10/13/64</p>	(ANR 930)	(ANR 930)	(ANR 930)

VA-IT-21

ROCKETDYNE










INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058233

Dwg. No. 208160-61

Model SR-7 DAWG

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY		
			Mech. & Date	Lead-man & Date	Insp. & Date
C	10/3/64 	PART NO. <u>208160-61 S/N 4058233 T.C.A. Test #090</u>			
		<u>Terminated After 13,280 sec of Run time due to over-temp. Ref Table II Note #3.</u>			
ACTION TAKEN			10-5-64		
<u>TRANSFERRED TO SHORTAGE 10/5/64</u>					
7	10/3/64 	PART NO. <u>208160-61 S/N 4058233 T.C.A. Decontaminated</u>			
		<u>up to 6.8.30</u>			
ACTION TAKEN			10-5-64		
<u>DECONTAMINATION COMPLETE THRU 6.8.37</u>					
		PART NO.			
		<u>Insp. Complete at C.T.E. #3</u>			
					
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					
		PART NO.			
ACTION TAKEN					

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 88 OF 380

REFERENCE: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20.1

7.1.5 Disassembly and Inspection

7.1.5.1 Test Procedure

- 7.1.5.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.
- 7.1.5.1.2 Section the TCA by cutting along line C-D-E as depicted in Figure 11.
- 7.1.5.1.3 Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatibility, corrosion, broken parts and impending failure.
- 7.1.5.1.4 After test completion identify the sectioned TCA and detailed parts and package and store for reference.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

257

PREPARED BY: E. Adams	DATE 7-20-64	APPROVED FOR NAA: <i>R. Y. Bide</i>	DATE 8-4-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>W. J. Adams</i>	DATE 8-3-64				

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 4388-5234

INTERNAL LETTER

North American Aviation, Inc.

DATE

20 November 1964

TO Those Concerned
Address

FROM
Address

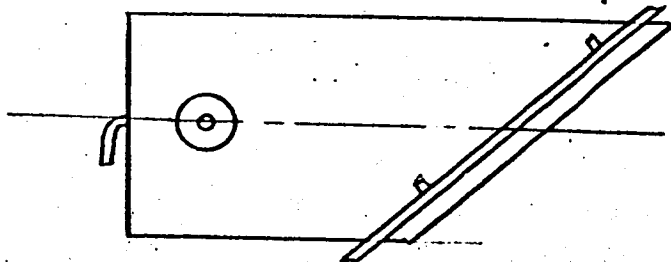
Gemini DAT-RAT Unit
D/896-388

SUBJECT Deviation From Specification 208160-401

Further disassembly and inspection is requested on 25 lb OAMS TCA Unit #1, P/N 208160-61, S/N 4058233, in order to evaluate the potting compound in the vicinity of the mounting bosses.

Pictures will be taken of the present condition of the TCA section and subsequent to additional sectioning.

Below is a sketch of the planned sectioning.



Approved:

R. G. Eide
R. G. Eide
Supervisor
Gemini DAT-RAT Unit

R. A. Cole
R. A. Cole
Gemini DAT-RAT Unit

J. Mavrogenis
J. Mavrogenis
MAC Engineering

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 89 OF 380

7.1.5.2 Post Test Inspection Data - TCA #1

7.1.5.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-265 (606)

Rocketdyne Part No. 208160-61 (606)

Component Serial No. 4058233 (606)

7.1.5.2.2 Preliminary Inspection (Reference paragraph 7.1.5.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows:

EXTERIOR OF TCA IS HEAVILY CONTAMINATED WITH HOT FLAME

RESIDUES, NAME PLATE IS MISSING, EXTRA LONG TUBE EXTENDING WITH FITTINGS ARE INSTALLED. 10/29/64 (606)

7.1.5.2.3 Disassembly and Inspection (Reference paragraph 7.1.5.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows:

VISUAL INSPECTION REVEALS SEPARATION OF ABLATIVE, CHARGED ABLATIVE, THROAT, LINES & SHELL.

THROAT IS GOBBED, NAME PLATE IS MISSING & VALVES HAVE BEEN REMOVED 11-3-64 (53)

PREPARED BY <u>E. Adams</u>	DATE <u>7-16-64</u>	PERFORMED BY <u>J. Adams</u>	DATE <u>11/2</u>	WITNESSED FOR NAA <u>R.D. Guich</u>	DATE <u>11-3-64</u>	CERTIFIED FOR McDONNELL, DATE <u>J.D. Wozniak 11/3/64</u>
				VERIFIED BY USAF <u>Bernard A. Duff</u>		DATE <u>11/3/64</u>

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 4388-5152

INTERNAL LETTER

North American Aviation, Inc.

DATE

22 October 1964

TO Those Concerned
Address

FROM
Address

Gemini DAT-RAT Unit
D/896-388

PHONE

6608

SUBJECT Plan of Action - Deviation to Gemini DAT TCA Specifications
208130-401 and 208160-401 for Purpose of
Completing Testing Requirements

The pre-functional failure on the RCS DAT Unit #1 oxidizer propellant valve, P/N 405557, S/N 875999, during the explosive atmosphere test necessitates the following deviations in order to accomplish completion of the prescribed testing.

Identical propellant valves are currently available on OAMS 25 lb DAT Unit #1, P/N 2081660-61, S/N 4058233, which has completed the prescribed test requirements for that unit. It is proposed that the propellant valves from this unit be utilized to conduct the remaining test requirements, explosive atmosphere and propellant resistance, for RCS 25 lb TCA Unit #1.

The procedures undertaken to accomplish the aforementioned shall be:

1. The propellant valves shall be removed from OAMS 25 lb TCA Unit #1.
2. The propellant valves of item 1 shall be subjected to a pre-functional test identical to the requirements of the DAT specification 208130-401, explosive atmosphere test. Quality control surveillance shall be required.
3. If the propellant valves successfully demonstrate fulfillment of the test requirements the results of the tests, the data sheets, duly certified, shall be inserted in the DAT specification attesting to the completion of the required explosive atmosphere pre-functionals.

R. Cole
R. Cole
Gemini DAT-RAT Unit

Approved: *W. Smith*
W. Smith
Supervisor
Propellant Controls

R. G. Eide
R. G. Eide
Supervisor
Gemini DAT-RAT Unit

R. Mantler
R. Mantler 22 Oct 64
MAC Rep.

PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE

6.1 Propellant Valve Proof Pressure and Leakage.

- 6.1.1 Install the TCA in a test setup as shown in Figure 2. If the propellant valves have been removed from the TCA, they shall be equipped with propellant valve outlet adapters. Do not attach the leakage sensing line at this time.

NOTE: It shall be necessary to perform this test in a hazardous test cell. See paragraph 3.8.

- 6.1.2 Slowly adjust the regulated helium supply pressure at the oxidizer propellant valve inlet to 500 ± 10 psig as indicated by the pressure gage.
- 6.1.3 Maintain this pressure for a period of not less than three minutes.
- 6.1.4 De-pressurize the oxidizer propellant valve.
- 6.1.5 Adjust the regulated helium supply pressure to 150 ± 10 psig.
- 6.1.6 Adjust the DC power supply to 26 ± 0.5 VDC.
- 6.1.7 Cycle the oxidizer propellant valve three times and leave in the closed position.
- 6.1.8 Attach the leakage sensing line and arrange the leakage testing equipment as shown in Figure 2.
- 6.1.9 Adjust the regulated helium supply pressure to 500 ± 10 psig.
-0

Prepared By:	Date	Checked By:	Date	Approved for NAA:
<i>H. C. K.</i>	10-21-64	<i>L. J. G.</i>	10-30-64	<i>R. Heide</i> 10-30-64

PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE

- 6.1.10 At first indication of leakage, wait at least two minutes to insure a steady leakage rate and then measure the leakage over a period of at least five minutes with a stopwatch. If no leakage is apparent after five minutes or if the measured leakage is less than 0.5 ml, record the leakage rate at "less than 0.1 scc He/MIN." The maximum allowable leakage is 2.23 scc He/MIN.
- 6.1.11 De-pressurize the oxidizer propellant valve. Disconnect the helium supply line, the DC power supply and the leakage sensing line. Cap the oxidizer propellant valve inlet port and electrical receptacle.
- 6.1.12 Failure to pass the above tests shall constitute a failure of the oxidizer valve. See paragraph 3.6.1.
- 6.1.13 Repeat the above procedure on the fuel propellant valve.
- 6.1.14 Remove the TCA from the test setup. Replace all protective covers.

262

R-15019-2

Prepared By:	Date	Checked By:	Date	Approved for NAA:
<i>1 E. C.</i>	<i>10-21-64</i>	<i>J. A. Long</i>	<i>10-30-64</i>	<i>B. Herda</i> <i>10-30-64</i>

PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE

- 6.1.10 At first indication of leakage, wait at least two minutes to insure a steady leakage rate and then measure the leakage over a period of at least five minutes with a stopwatch. If no leakage is apparent after five minutes or if the measured leakage is less than 0.5 ml, record the leakage rate at "less than 0.1 scc He/MIN." The maximum allowable leakage is 2.23 scc He/MIN.
- 6.1.11 De-pressurize the oxidizer propellant valve. Disconnect the helium supply line, the DC power supply and the leakage sensing line. Cap the oxidizer propellant valve inlet port and electrical receptacle.
- 6.1.12 Failure to pass the above tests shall constitute a failure of the oxidizer valve. See paragraph 3.6.1.
- 6.1.13 Repeat the above procedure on the fuel propellant valve.
- 6.1.14 Remove the TCA from the test setup. Replace all protective covers.

262

R-15019-2

Prepared By:	Date	Checked By:	Date	Approved for NAA:
<i>J. E. L.</i>	<i>10-21-64</i>	<i>J. A. L.</i>	<i>10-30-64</i>	<i>R. H. L.</i> <i>10-30-64</i>

PROPELLANT VALVE ELECTRICAL RESISTANCE

6.3 Propellant Valve Electrical Resistance

- 6.3.1 Install the electrical harness on the propellant valves. Provide an environmental temperature of 70 ± 5 F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than ± 3 F for a 30 minute time period.
- 6.3.2 Adjust the impedance bridge to measure resistance.
- 6.3.3 Measure and record the resistance between leads A and B of the oxidizer valve. The acceptable resistance is presented in Figure 12.
- 6.3.4 Measure and record the resistance between leads C and D of the oxidizer valve. The maximum acceptable resistance is 1.0 ohm.
- 6.3.5 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.
- 6.3.6 Repeat paragraphs 6.3.3 and 6.3.4 on the fuel valve.
- 6.3.7 Remove Electrical harness from propellant valves and replace protective covers on propellant valve electrical connectors.

Prepared By:	Date	Checked By:	Date	Approved for NAA:
R Co Co	10-21-64	J. A. Gange	10-30-64	J. H. Erde 10-30-64

PROPELLANT VALVE DIELECTRIC STRENGTH

6.4 Propellant Valve Dielectric Strength

- 6.4.1 Install the electrical harness on the propellant valves. Attach ground leads to each of the propellant valve electrical connector bodies by means of alligator clips.
- 6.4.2 Adjust the 60 cps AC voltage output of the leakage tester to zero.
- 6.4.3 Set the capacity compensation selector switch on the leakage tester to "NONE".
- 6.4.4 Connect one of the leakage tester leads to lead A of the oxidizer valve and the other lead to the oxidizer valve ground lead.
- 6.4.5 Depress power switch on the leakage tester, and adjust the voltage control until 500 ± 10 VRMS is indicated on the voltmeter. If the leakage tester ammeter reads off-scale, reduce the voltage until approximately 800 microamps is indicated on the ammeter.
- 6.4.6 Rotate the capacity compensation selector switch until a minimum current flow is indicated on the ammeter.
- 6.4.7 Adjust the voltage control until 500 ± 10 VRMS is indicated on the voltmeter.
- 6.4.8 Observe the ammeter for a period of one minute. Maximum allowable current leakage is 500 micro-amps.
- 6.4.9 Release the leakage tester power switch and disconnect the leakage tester leads.

Prepared By:	Date	Checked By:	Date	Approved for NAA:
NEC	10-21-64	J. A. Sanger	10-30-64	R. Heide 10-30-64

PROPELLANT VALVE DIELECTRIC STRENGTH

- 6.4.10 Repeat paragraphs 6.4.2 and 6.4.3.
- 6.4.11 Connect one of the leakage tester leads to lead C of the oxidizer valve and the other lead to the oxidizer valve ground lead.
- 6.4.12 Repeat paragraphs 6.4.5 through 6.4.9.
- 6.4.13 Repeat paragraphs 6.4.2 and 6.4.3.
- 6.4.14 Connect one of the leakage tester leads to lead A of the oxidizer valve and the other to lead C of the oxidizer valve.
- 6.4.15 Repeat paragraphs 6.4.5 through 6.4.9.
- 6.4.16 Failure to pass the above test shall constitute a failure of the propellant valve. See paragraph 3.6.
- 6.4.17 Repeat paragraphs 6.4.2 through 6.4.15 on the fuel valve.
- 6.4.18 Remove the electrical harness and the ground leads from the propellant valves and replace the propellant valve protective covers.
- 6.4.19 Replace protective caps.

Prepared By: Date	Checked By: Date	Approved for NAA:
<i>H Cole</i> 10-21-64	<i>J A Sanger</i> 10-30-64	<i>D F Heride</i> 10-30-64

PROPELLANT VALVE FUNCTIONAL

- 6.5.8 Adjust the GN₂ supply pressure to 300 \pm 10 psig.
- 6.5.9 Adjust the DC power supply voltage to zero.
- 6.5.10 Close the mercury switch.
- 6.5.11 Increase the DC power supply voltage until the oxidizer valve opens as indicated by a pressure drop. The maximum acceptable pull in voltage is 16 VDC as indicated on the output voltmeter.
- 6.5.12 Reduce the GN₂ supply pressure to zero.
- 6.5.13 Reduce the DC power supply voltage until the propellant valve closes. Note deflection on milliammeter which indicates valve closing. Record valve closing voltage. The minimum acceptable drop out voltage is 1.0 volts.
- 6.5.14 Open the mercury switch.
- 6.5.15 Failure to pass the above test shall constitute a failure of the oxidizer valve. See paragraph 3.6.
- 6.5.16 Repeat paragraphs 6.5.1 through 6.5.15 on the fuel propellant valve.
- 6.5.17 Remove electrical leads and the GN₂ supply.
- 6.5.18 Replace all protective closures.

Prepared By: Date	Checked By: Date	Approved for NAA:
<i>P. Cole</i> 10-21-64	<i>L. King</i> 11-30-64	<i>P. H. Eide</i> 10-30-64

PROPELLANT VALVE FUNCTIONAL

6.5 Propellant Valve Functional

- 6.5.1 Install the TCA in a test setup as shown in Figure 4. Provide a temperature environment of 70 ± 5 F until temperature stabilization is obtained. Stabilization is defined as a temperature variation of not more than ± 3 F for a 30 minute time period. Connect the current trace lead to the oxidizer valve. Do not connect the voltage trace lead.
- 6.5.2 Adjust the pressure regulator to obtain 300 ± 10 psig on the pressure gage.
- 6.5.3 Adjust the DC power supply so that 26 ± 0.5 VDC is read on the voltmeter.
- 6.5.4 Close the mercury switch and record the oscilloscope current trace with the Polaroid camera. A sample current trace is shown in Figure 5. The maximum valve opening response time is 0.0065 seconds from electrical signal to poppet open. See Figure 5 for typical valve opening response characteristics. Open the mercury switch.
- 6.5.5 Reduce the GN₂ supply pressure to zero.
- 6.5.6 Disconnect the current trace lead and connect the voltage trace lead.
- 6.5.7 Close the mercury switch to verify that the oxidizer valve has opened. Then open the mercury switch and record the oscilloscope voltage trace with the Polaroid camera. A sampling voltage trace is shown in Figure 5. The maximum valve closing response time is 0.0035 seconds from electrical signal to poppet closed.

Prepared By:	Date	Checked By:	Date	Approved for NAA:
R Cole	10-21-64	LA Banger	10-30-64	R F Eide 10-30-64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO 208160-401 ^{89.01} SHEET OF 380 D

- Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.13.
- 7.1.6 Explosive Atmosphere - TCA #1
- 7.1.6.1 Test Procedure
- 7.1.6.1.1 Perform Propellant Valve Removal.
- 7.1.6.1.2 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1.
- 7.1.6.1.3 Perform Propellant Valve Electrical Resistance per paragraph 6.3.
- 7.1.6.1.4 Perform Propellant Valve Dielectric Strength per paragraph 6.4.
- 7.1.6.1.5 Perform Propellant Valve Functional per paragraph 6.5.
- 7.1.6.1.6 Install the propellant valves in an explosion test chamber in accordance with Figure 13.
- 7.1.6.1.7 Instrumentation shall be provided for monitoring propellant valve body temperature and the test chamber ambient air temperature.
- 7.1.6.1.8 Seal the explosion test chamber and raise the internal temperature to 160 \pm 5 F.
- 7.1.6.1.9 Allow the temperature of the propellant valve to rise within 20 F of the temperature of paragraph 7.1.6.1.8.
- 7.1.6.1.10 Reduce the pressure within the test chamber to simulate a pressure altitude of 10,000 feet above the desired test altitude. The desired test altitude for the first test is sea level.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole RC	10-31-64	<i>[Signature]</i>	10-31-64	<i>[X]</i>	
CHECKED BY:	DATE				
<i>[Signature]</i>	10-31-64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.02 OF 380

- 7.1.6.1.11 Introduce into the test chamber, in proper quantity, commercial butane so that an explosive atmosphere is attained for the desired test altitude.
- 7.1.6.1.12 Return the test chamber's pressure altitude to 5000 feet above the desired test altitude by admitting air to the chamber.
- 7.1.6.1.13 Allow the test chamber's explosive mixture to circulate for a period of three minutes.
- 7.1.6.1.14 Energize the spark exciter within the combustion sampling chamber of the test chamber.
- 7.1.6.1.15 If combustion is demonstrated within the combustion sampling chamber of the test chamber proceed with paragraph 7.1.6.1.16. If not, vent and purge the test chamber and repeat paragraphs 7.1.6.1.8 through 7.1.6.1.15.
- 7.1.6.1.16 Energize the oxidizer valve with 26 ± 1 VDC for a period of 10 seconds. Then de-energize. Explosion generated by actuation of the oxidizer valve shall constitute a failure. See paragraph 3.6.
- 7.1.6.1.17 Energize the fuel valve with 26 ± 1 VDC for a period of 10 seconds. Then de-energize. Explosion generated by actuation of the fuel valve shall constitute a failure. See paragraph 3.6.
- 7.1.6.1.18 Repeat paragraphs 7.1.6.1.16 through 7.1.6.1.17 nine successive times.
- 7.1.6.1.19 If explosion did not occur during performance of paragraphs 7.1.6.1.16 through 7.1.6.1.18, slowly admit air to the test chamber to produce a simulated pressure altitude of 5000 feet below the desired test altitude. If the desired test altitude is sea level, reduce the test chamber altitude to sea level. As the altitude is being lowered, perform paragraphs 7.1.6.1.16 and 7.1.6.1.17 once during each 1000 feet of drop.

PREPARED BY: R. Cole <i>RC</i> 10-31-64	DATE 10-31-64	APPROVED FOR NAA: <i>R. Heide</i> 10-31-64	DATE 10-31-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE 10-31-64
CHECKED BY: <i>[Signature]</i> 10-31-64	DATE 10-31-64				

FORM 608-B-38 NEW 6-63

R-15019-2

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.03 OF 380

D

- 7.1.6.1.20 Repeat paragraph 7.1.6.1.14. If combustion is not demonstrated vent and purge test chamber and repeat paragraphs 7.1.6.1.8 through 7.1.6.1.20.
- 7.1.6.1.21 Vent and purge the test chamber.
- 7.1.6.1.22 Repeat paragraphs 7.1.6.1.8 through 7.1.6.1.21 for each of the following desired test altitudes: 5000 feet, 10,000 feet, 20,000 feet, 30,000 feet, 40,000 feet and 50,000 feet.
- 7.1.6.1.23 Remove all test equipment, pressurant and electrical connections from the propellant valves.
- 7.1.6.1.24 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.
- 7.1.6.1.25 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.
- 7.1.6.1.26 Perform Propellant Valve Dielectric Strength per paragraph 6.4.
- 7.1.6.1.27 Perform Propellant Valve Functional Test per paragraph 6.5.
- 7.1.6.1.28 Replace protective covers.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole <i>RC</i>	10-31-64	<i>P. Heide</i> 10-31-64	10-31-64	 	
CHECKED BY:	DATE				
<i>G. Dennis</i>	10-31-64				

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.04 OF 320 D

7.1.6.2 Test Data - TCA #1

7.1.6.2.1 918 Component Identification

Component Name	Oxidizer Valve	Fuel Valve
Rocketdyne Part No.	<u>407559</u>	<u>407560</u>
Component Serial No.	<u>9193579</u>	<u>4059525</u>

918

PREPARED BY R. Cole RC 10-31-64	DATE 11-5-64	PERFORMED BY <i>[Signature]</i> 11-5-64	DATE 11-5-64	WITNESSED FOR NAA <i>[Signature]</i> 11-5-64	DATE 11-5-64	CERTIFIED FOR McDONNELL I.D. M. H. ROSEN 109150 VERIFIED BY USAF 5/11/64	DATE 11-5-64
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FORM 608-B-39 NEW 6-63

R-15019-2

Oxidizer
Valve

Fuel
Valve

Rocketdyne P/N

Rocketdyne S/N

407559

9193579



407560

4059575



Prepared by Date

R C L 10-21-64

Performed by Date

H. A. Lundwall
10-30-64

Witnessed for Date
NAA

E J J 10-30-64



Verified by USAF



10-30-64

PROPELLANT VALVE PROOF PRESSURE AND LEAKAGE TEST (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ⁺¹⁰) -0	500 psig	500 psig
Time Duration (3 minimum)	3 minutes	3 minutes
Leakage Voltage (26 ^{+0.5})	26 VDC	26 VDC
Inlet Pressure (500 ⁺¹⁰) -0	500 psig	500 psig
Time Duration (5 minimum)	5 minutes	5 minutes
Leakage Rate (2.23 maximum)	ZERO SCC He min	ZERO SCC He min
Inspection Remarks	NONE 11/30/64	

Prepared by Date A.C.G. 10-21-64	Performed by Date H.A. Lindwall 10-30-64	Witnessed for Date NAA E.P. Smith 11-3-64	Verified by USAF 10-31-64
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PROPELLANT VALVE ELECTRICAL RESISTANCE TEST (reference para.6.3)

Environmental Temperature 70 (70±10°F) WJ 10-30-64

Resistance A - B 42.01 ohms (Acceptable per Figure 9, yes or no YES)

Oxidizer Valve 42.51 ohms (Acceptable per Figure 9, yes or no YES)

Fuel Valve .22 ohms

Resistance C - D (1.0 maximum) .19 ohms

Oxidizer Valve .19 ohms

Fuel Valve .19 ohms

Inspection Remarks NONE 10-30-64 WJ 10-30-64

Prepared by Date <u>RCole 10-21-64</u>	Performed Date by <u>H.A. Lindwall 10-30-64</u>	Witnessed for Date NAA <u>CT Jones 10-30-64</u>	Verified by USAF <u>10-30-64</u>
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PROPELLANT VALVE DIELECTRIC STRENGTH TEST (reference para. 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 ⁺¹⁰ ₋₀	Current Microamps 500 max.	Voltage Volts 500 ⁺¹⁰ ₋₀	Current Microamps 500 max.
A to Ground	500 (921)	38 (921)	500 (921)	34 (921)
C to Ground	500 (921)	40 (921)	500 (921)	42 (921)
A to C	500 (921)	14 (921)	500 (921)	6 (921)

Inspection Remarks NONE 10-30-64 (921)













Prepared by Date <i>K.E. 10-21-64</i>	Performed by Date <i>H.A. Lindwall 10-30-64</i>	Witnessed for Date NAA <i>C.T. 10-30-64</i> (921)	Verified by USAF <i>10-30-64</i> (921)
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PROPELLANT VALVE FUNCTIONAL TEST (reference paragraph 6.5)











Oxidizer Valve

Fuel Valve

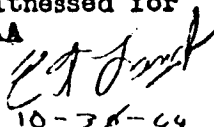


Response Time

Ambient Temperature (70±10)	 70 F	 70 F
Energizing Voltage (26±0.5)	 26 VDC	 26 VDC
Inlet Pressure (300±10 for "pull-in")	 300 psig	 300 psig
Opening Time (0.0065 maximum)	 .0038 seconds	 .0036 seconds
Inlet Pressure (zero for "drop-out")	 ZERO psig	 ZERO psig
Closing Time (0.0035 maximum)	 .0030 seconds	 .0026 seconds

Low Voltage Operation

Ambient Temperature (70±10)	 70 F	 70 F
Inlet Pressure (300±10 for "pull-in")	 300 psig	 300 psig
Opening Voltage (16 maximum)	 8.0 VDC	 5.5 VDC
Inlet Pressure (zero for "drop-out")	 ZERO psig	 ZERO psig
Closing Voltage (1.0 minimum)	 1.8 VDC	 1.05 VDC

Inspection Remarks NONE 

Prepared by Date JEG 10-21-64	Performed by Date H.A. Lundwall 10-30-64	Witnessed for NAA  10-30-64	Date 	Verified by USAF  10-30-64
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ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 683369	FACILITY ENV.LAB	PHONE 2061	DATE 10-30-64
PART SE7 25# TCA Propellant Valve	PART NO. 407559 S/N 9193579	TYPE OF TEST Pre-Explosive Atmosphere Functional		

OXIDIZER VALVE				
CURRENT TRACE (OPENING TIME)				
Horizontal	=	0.5 ms/cm		
Vertical	=	5 mv/cm		
Requirement	=	0.0065 sec/max		
Actual	=	0.0038 sec		
VOLTAGE TRACE (CLOSING TIME)				
Horizontal	=	0.5 ns/cm		
Vertical	=	10 v/cm		
Requirement	=	0.0035 sec/max		
Actual	=	0.0030 sec		

PREPARED BY F. Pope	EWR NO. 638369	FACILITY ENV.LAB.	PHONE 2061	DATE 10-30-64
PART SE7 25# TCA Propellant Valve	PART NO. 407560 S/N 4059525	TYPE OF TEST Pre Explosive Atmosphere Functional		

FUEL VALVE

CURRENT TRACE

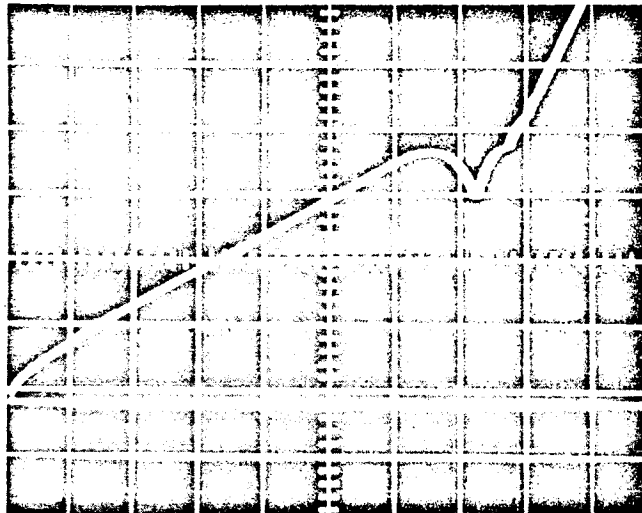
(OPENING TIME)

Horizontal = 0.5 ms/cm

Vertical = .5 mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0036 sec



VOLTAGE TRACE

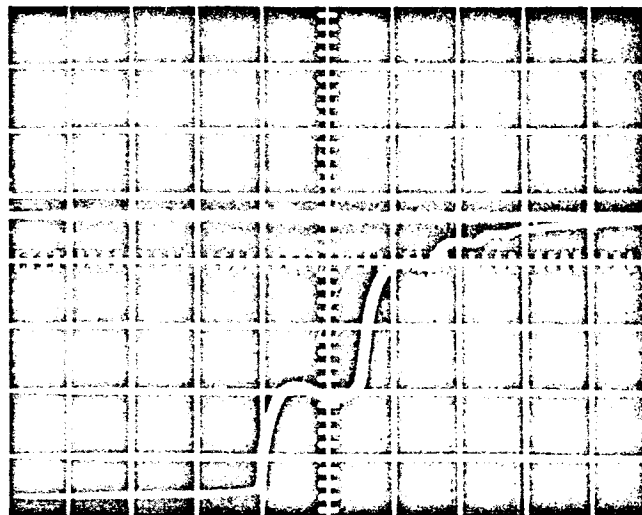
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0026 sec



**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.05 OF 380 D

7.1.6.2.6 Explosive Atmosphere Test (reference paragraph 7.3.3.1)

The propellant valves were tested at the following pressure altitudes for explosion producing characteristics YES (yes or no).

Pressure Altitude (feet)	The Propellant Valves Passed the Test (yes or no)
Sea Level to 5000	YES (A-918)
Sea Level to 10,000	YES (A-918)
5000 to 15,000	YES (A-918)
15,000 to 25,000	YES (A-918)
25,000 to 35,000	YES (A-918)
35,000 to 45,000	YES (A-918)
45,000 to 55,000	YES (A-918)

Inspection Remarks: TESTING STARTED ON 11-5-64
AT 0945. TESTING WAS CONDUCTED AT SSFL COMPONENT
LAB.
ABOVE TESTING COMPLETED 11-5-64 - 1440 (A-918)













PREPARED BY R. Cole RC. 10-31-64	DATE 11-5-64	PERFORMED BY <i>[Signature]</i> 11-5-64	DATE 11-5-64	WITNESSED FOR NAA <i>[Signature]</i> 11-5-64	DATE 11-5-64	CERTIFIED FOR McDONNELL VERIFIED BY USAF <i>[Signature]</i> 5/2/64	DATE 5/2/64
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FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.06 OF 380

7.1.6.2.7 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 ± 10)	 <u>500</u> psig	 <u>500</u> psig
Time Duration (3 minimum)	 <u>3</u> minutes	 <u>3</u> minutes
Leakage Voltage (26 \pm 0.5)	 <u>26</u> VDC	 <u>26</u> VDC
Inlet Pressure (500 ± 10)	 <u>500</u> psig	 <u>500</u> psig
Time Duration (5 minimum)	 <u>5</u> minutes	 <u>5</u> minutes
Leakage Rate (2.23 maximum)	 <u><.1</u> SCC He min	 <u><.1</u> SCC He min

Inspection Remarks

NONE

PREPARED BY <u>E. Adams</u>	DATE <u>9/10/64</u>	PERFORMED BY <u>Leece</u>	DATE <u>11/6/64</u>	WITNESSED FOR NAA <u>W.B. Katnerich</u>	DATE <u>11-6-64</u>	CERTIFIED FOR McDONNELL <u>RL Free</u>	DATE <u>11-6-64</u>
	<u>5/29/64</u>	<u>Noeller</u>	<u>1/64</u>			VERIFIED BY USAF <u>RL Free</u>	DATE <u>11/6/64</u>

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.07 OF 380

7.1.6.2.8 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 \pm 10F)

Resistance

A - B

Oxidizer Valve

41.02 ohms (Acceptable per Figure 9.3)

Yes or No YES

Fuel Valve

42.39 ohms (Acceptable per Figure 9.3)

Yes or No YES

Resistance

C - D

(1.0 maximum)

Oxidizer Valve

0.08 ohms

Fuel Valve

.75 ohms

Inspection Remarks

NONE

PREPARED BY E. Adams <i>EA</i>	DATE <u>11/10/64</u>	PERFORMED BY <i>[Signature]</i>	DATE <u>11/15/64</u>	WITNESSED FOR NAA <i>[Signature]</i>	DATE <u>11/15/64</u>	CERTIFIED FOR McDONNELL <i>[Signature]</i>	DATE <u>11/16/64</u>
						VERIFIED BY USAF <i>[Signature]</i>	DATE <u>11/16/64</u>

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25// PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 89.08
SHEET OF 280 D

7.1.6.2.9 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 \pm 10	Current Microamps 500 max.	Voltage Volts 500 \pm 10	Current Microamps 500 max.
A to Ground	500V	49 μ a (AVR 241)	500V	24 μ a (AVR 241)
C to Ground	500V	49 μ a (AVR 241)	500V	50 μ a (AVR 241)
A to C	500V	21 μ a (AVR 241)	500V	21 μ a (AVR 241)

Inspection Remarks

NCNE 6/Nov/64 (AVR 241)

PREPARED BY <i>EA</i> E. Adams	DATE <i>11/10/64</i>	PERFORMED BY <i>James W. Hester</i>	DATE <i>6/Nov/64</i>	WITNESSED FOR NAA <i>[Signature]</i> (AVR 241)	DATE <i>6/Nov/64</i>	CERTIFIED FOR McDONNELL <i>[Signature]</i> VERIFIED BY USAF <i>[Signature]</i>	DATE <i>6/Nov/64</i>
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FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 89.09 OF 380 D

7.1.6.2.10 Propellant Valve Functional Test (reference paragraph 6.5)

Oxidizer Valve Fuel Valve

Response Time

Ambient Temperature (70 ±10)	ANR 941 <u>70°</u> F	ANR 941 <u>70°</u> F
Energizing Voltage (26 ±0.5)	ANR 941 <u>26.0</u> VDC	ANR 941 <u>26.0</u> VDC
Inlet Pressure (300 ±10 for "pull-in")	ANR 941 <u>300</u> psig	ANR 941 <u>300</u> psig
Opening Time (0.0065 maximum)	ANR 941 <u>0.039</u> seconds	ANR 941 <u>0.036</u> seconds
Inlet Pressure (zero for "drop-out")	ANR 941 <u>ZERO</u> psig	ANR 941 <u>ZERO</u> psig
Closing Time (0.0035 maximum)	ANR 941 * <u>0.0033</u> seconds	ANR 941 <u>0.0026</u> seconds

Low Voltage Operation

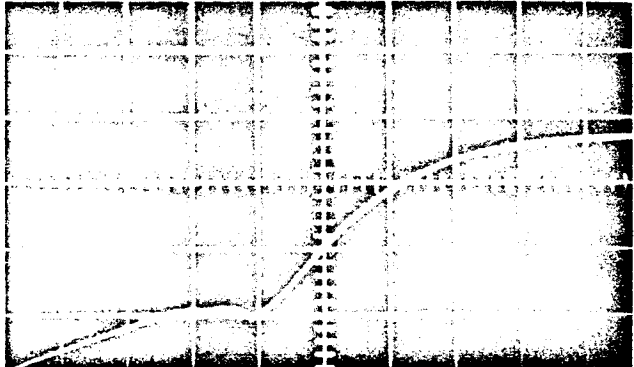
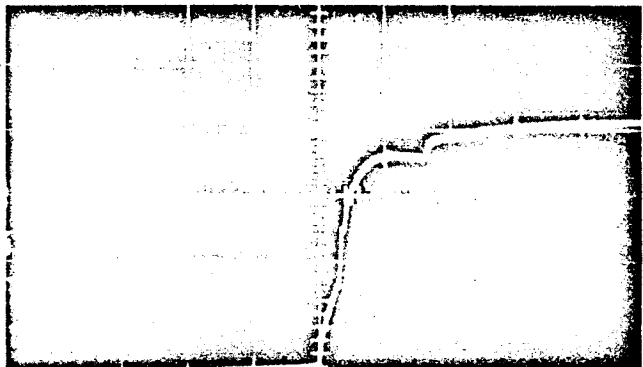
Ambient Temperature (70 ±10)	ANR 941 <u>70°</u> F	ANR 941 <u>70°</u> F
Inlet Pressure (300 ±10 for "pull-in")	ANR 941 <u>300</u> psig	ANR 941 <u>300</u> psig
Opening Voltage (16 maximum)	ANR 941 <u>8.10</u> VDC	ANR 941 <u>6.0</u> VDC
Inlet Pressure (zero for "drop-out")	ANR 941 <u>ZERO</u> psig	ANR 941 <u>ZERO</u> psig
Closing Voltage (1.0 minimum)	ANR 941 <u>1.85</u> VDC	ANR 941 <u>1.10</u> VDC

Inspection Remarks * INSPECTION ON OSCILLOSCOPE

ALL RESULTS WERE INTERPRETED (ANR 941)

PREPARED BY E. Adams Et	DATE 1/10/64	PERFORMED BY J. Adams 1/10/64	DATE 1/10/64	WITNESSED FOR NAA J. Adams 1/10/64	DATE 1/10/64	CERTIFIED FOR McDONNELL J. Adams 1/10/64	DATE 1/10/64
VERIFIED BY USAF						DATE 1/10/64	

FORM 608-B-39 NEW 6-63

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV. LAB.	PHONE 2061	DATE 11-6-64
PART SE7 25# TCA Propellant Valve	PART NO. 407559 S/N 9193579	TYPE OF TEST Post Explosive Atmosphere Functional		
OXIDIZER VALVE				
CURRENT TRACE (OPENING TIME)				
				
Horizontal	= 1 ms/cm			
Vertical	= 20 mv/cm			
Requirement	= 0.0065 sec/max			
Actual	= 0.0039 sec			
VOLTAGE TRACE (CLOSING TIME)				
				
Horizontal	= 0.5 ms/cm			
Vertical	= 10 v/cm			
Requirement	= 0.0035 sec/max			
Actual	= 0.0033 sec			

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.LAB.	PHONE 2061	DATE 11-6-64
PART SE7 25# TCA Propellant Valve	PART NO. 407560 S/N 4059525	TYPE OF TEST Post Explosive Atmosphere Functional		

FUEL VALVE

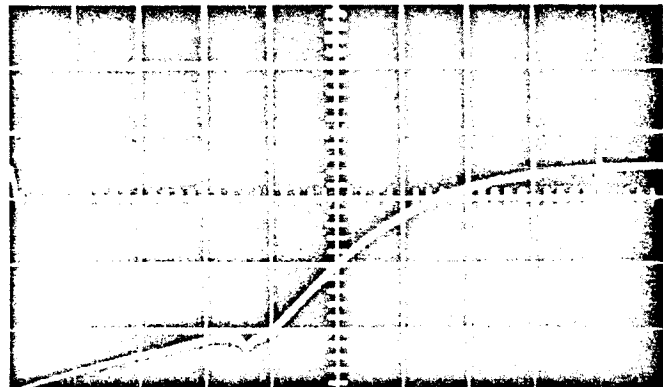
CURRENT TRACE
(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 20 mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0036 sec



VOLTAGE TRACE

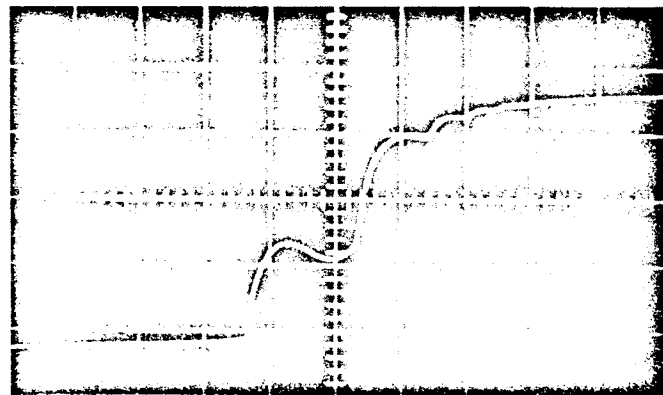
(CLOSING TIME)

Horizontal * 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0026 sec



DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61

NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.10 OF 380

Reference: MAC SCD 52-52700, Revision G, Paragraph 6.2.3.18 and 19

7.1.7 Fuel and Oxidizer Resistance - TCA #1

7.1.7.1 Test Procedure

7.1.7.1.1 Install the oxidizer propellant valve as shown in Figure 12.
Close V₁₀.

7.1.7.1.2 Attach to the inlet of V₁₀ a Nitrogen Tetroxide propellant supply.

7.1.7.1.3 Adjust the propellant supply pressure to 150 \pm 15 psig.

7.1.7.1.4 Open V₁₀. Adjust the IC power supply to 26 \pm 2 VDC. Energize the propellant valve. When propellant (liquid or vapor) appears at the discharge, de-energize the propellant valve.

7.1.7.1.5 Adjust the environmental temperature to 160 \pm 5 F. When the propellant valve body temperature reaches this temperature record the date and the time on the data sheet. The propellant valve shall be exposed to propellant at the above temperature for a period of two weeks (336 hours).

7.1.7.1.6 Activate oscilloscope to record propellant valve voltage and current traces. (This will require two actuations to obtain the opening and closing responses). Energize the propellant valve with 26 \pm 2 VDC. When propellant (liquid or vapor) appears at the discharge, de-energize the propellant valve. (As a result the valve "on" time will take place over a relatively short period of time. It is intended this way to avoid problem of disposing of large amounts of propellant).

7.1.7.1.7 Repeat paragraph 7.1.7.1.6 three times daily at equally spaced intervals during the two week exposure period.

PREPARED BY: R. Cole	DATE 11-2-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 11-2-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE <i>[Signature]</i>
CHECKED BY: <i>[Signature]</i>	DATE 11-2-64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
401 89.11
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160 SHEET OF 320

- 7.1.7.1.8 At the end of the two week period close V₁₀ and record the date and the time on the data sheet.
- 7.1.7.1.9 Attach a GN₂ supply to the inlet of V₁₀. Open V₁₀ and supply GN₂ to the propellant valve at 120 +10 psig and 160 +10F. Energize the propellant valve with 12 ±2 VDC for a period of 3 minutes. Then cycle the valve at the same temperature and pressure as follows for ten (10) times, using 26 ±1 VDC.
- (a) 5 ±1 seconds on time
(b) 5 ±1 seconds off time .
Close V₁₀ and disconnect the GN₂ supply.
- 7.1.7.1.10 Attach a Freon TF supply to the inlet of V₁₀. Open V₁₀ and supply Freon TF to the propellant valve at 35 to 50 psig. Energize the propellant valve with 12 ±2 VDC for a period of 3 minutes. Then cycle the valve at the same pressure as follows for ten (10) times, using 26 ±1 VDC.
- (a) 5 ±1 seconds on time
(b) 5 ±1 seconds off time
Close V₁₀ and disconnect the Freon TF supply. Repeat paragraph 7.1.7.1.9.
- 7.1.7.1.11 Remove the propellant valve from the test setup.
- 7.1.7.1.12 Perform Propellant Valve Electrical Resistance per paragraph 6.3.
- 7.1.7.1.13 Perform Propellant Valve Functional per paragraph 6.5 on the oxidizer propellant valve at the temperature of paragraph 7.1.7.1.5.
- 7.1.7.1.14 Perform Propellant Valve Dielectric Strength per paragraph 6.4 on the oxidizer propellant valve at the temperature of paragraph 7.1.7.1.5.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole	10-31-64	<i>[Signature]</i>	10-31-64	<i>[Signature]</i>	
CHECKED BY:	DATE				
<i>[Signature]</i>	10-31-64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
401 89.12
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160 SHEET OF 380

- 7.1.7.1.15 Perform Propellant Valve Proof Pressure and Leakage per paragraph 6.1 on the oxidizer propellant valve at the temperature of paragraph 7.1.7.1.5.
- 7.1.7.1.16 Perform Propellant Valve Load Analysis per paragraph 6.9 on the oxidizer propellant valve. Adjust the propellant valve body temperature to the temperature specified in paragraph 7.1.7.1.5.
- 7.1.7.1.17 Repeat paragraphs 7.1.7.1.12 through 7.1.7.1.15 except that the environmental temperature of paragraph 7.1.7.1.5 shall be changed to 15 ± 5 F.
- 7.1.7.1.18 Repeat paragraphs 7.1.7.1.1 through 7.1.7.1.16 on the fuel propellant valve except that the propellant as specified in paragraph 7.1.7.1.2 shall be Monomethyl Hydrazine and that the flushing fluid as specified in paragraph 7.1.7.1.10 shall be alcohol.

PREPARED BY: R. Cole <i>RC</i> 10-31-64	DATE 10-31-64	APPROVED FOR NAA: <i>[Signature]</i> 10-31-64	DATE 10-31-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE 10-31-64
CHECKED BY: <i>[Signature]</i> 10-31-64	DATE 10-31-64				

FORM 608-B-38 NEW 6-63

SE 725 3774
DUST 241
PROP. VALVES

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

4193579
Serial No. 4659525
Dwg. No. 52-52701
Model Se-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY		
			Mech. & Date	Lead-man & Date	Insp. & Date
1	11/12/64	BEER BUTTE S/S PART NO. 2345 TEST on The MMH valve 11/12/64 The Discharge was Black -- Replaced "O" downstream of Value.		11/13/64	11/13/64
2	11/14/64	PART NO. 407559 IN 9193579 Valve is inoperative after fire in oven sometime between 11:30 check and 7:30 check suspect Leak at fitting between filters ACTION TAKEN: FILTERS - Replaced "O" Ring MS 28774-114 washer 2118-011 Seal 2118-014 O'Ring AND RD 262-3003-0004 Seal OFR. 12895 R.		11/14/64	
3	11/18/64	PART NO. 407559 IN 9193579 OYID valve unable to decontam valve as to para 7.67.1.9 to 7.67.1.0. ACTION TAKEN: OFR 12895 R.		11/14/64	
4	11/14/64	PART NO. 407560 IN 4059525 FUEL valve "O" Ring between filters no good starting to deteriorate. ACTION TAKEN: REPLACED WITH MS 28774-114 O'RING WASHER, 2118-011 SEAL, 2118-014 O'RING, AND RD 262-3003-0004 SEAL. Ref. IL 4388-5219 Dated Mar-17-64		11-17-64	
5	11/18/64	PART NO. 407560 S/N. 4059525 FUEL VALVE. Typographic Error on IL 4388-5219 Page 2. ON LOW VOLTAGE Operation Closing Voltage is (1.0 MAXIMUM) Should be (1.0 MINIMUM) ACTION TAKEN: Ref. AVO FROM E. ADAMS DATED 11-18-64 TO CORRECT TYPE. ERROR ON IL 4388-5219		11-20-64	

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

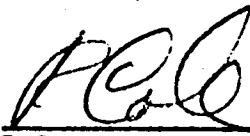
COMPONENT NAME THRUST CHAMBER ASSEMBLY -25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160 ⁴⁰¹ SHEET OF

Deviation Request:

It is hereby authorized to accept the following deviations to the resistance testing. (Paragraph 7.1.7)

- (1) Change the temperature of the GN₂ to 160 \pm 20° F.
Reference paragraph 7.1.7.1.9.
- (2) Decontaminate both propellant valves as per paragraphs 7.1.7.1.9 and 7.1.7.1.10 prior to resistance testing.
(Fluid for fuel propellant valve called out in paragraph 7.1.7.1.18).

Recopied from original request dated 9 November 1964.


R. Cole
Gemini Dat-Rat Unit


James D. Mavrogenis
MAC Engineering

12-18-64

IL 4388-5219

INTERNAL LETTER

North American Aviation, Inc.

DATE

17 November 1964

TO
Address

Those Concerned

FROM
Address

Gemini DAT-RAT Unit
D/896-388

SUBJECT

SE7 25 lb TCA, DAT Unit #1, Propellant Valve,
P/N 407560, S/N 4059525

Due to an improper facility test setup during the propellant resistance testing of the subject valve there exists a possibility of contaminants in the valve.

The following steps shall be undertaken to insure the valve is still in acceptable operating condition and to preclude a similar occurrence.

1. Disassemble test facility filter assemblies and install proper seals.
2. Flush propellant valve as per paragraphs 7.1.7.1.9, 7.1.7.1.10 and 7.1.7.1.18 in DAT specification 208160-401.
3. Perform the propellant valve functional, paragraph 6.5.

Pertinent procedure directives will be enclosed to assure compliance with the steps described.

Upon satisfactory completion of the above, resumption of the fuel resistance test will take place.

Approved:

R. G. Eide
R. G. Eide
Supervisor
Gemini DAT-RAT Unit

R. A. Cole
R. A. Cole
Gemini DAT-RAT Unit

R. L. Mantler
R. L. Mantler
MAC Engineering

The fuel propellant valve was flushed per 7.1.7.1.9, 7.1.7.1.10 and 7.1.7.1.18 yes (yes or no).

Response Time

Ambient Temperature
(70 \pm 10)
Energizing Voltage
(26 \pm 0.5)
Inlet Pressure
300 \pm 10 for "pull-in"
Opening Time
(0.0065 maximum)
Inlet Pressure
(zero for "drop-out")
Closing Time
(0.0035 maximum)

Fuel Valve

70° F
26.0 VDC
300 psig
0.0036 seconds
Zero psig
0.00265 seconds

Low Voltage Operation

Ambient Temperature
(70 \pm 10)
Inlet Pressure
(300 \pm 10 for "pull-in")
Opening Voltage
(16 maximum)
Inlet Pressure
(zero for "drop-out")
Closing Voltage
(1.0 minimum)
Ref. Disc. #5

70° F
300 psig
6 VDC
Zero psig
1.06 VDC

Inspection Remarks NONE

Prepared By: Date: Performed By: Date: Witnessed for NAA: Date:

R. Cole

11-17-64

F. E. Pope

11-18-64

E. Stroh

11/18/64

Verified By USAF:

Date:

18 Nov 64

Rev. A. D. Marmorens Date 12-16-64

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

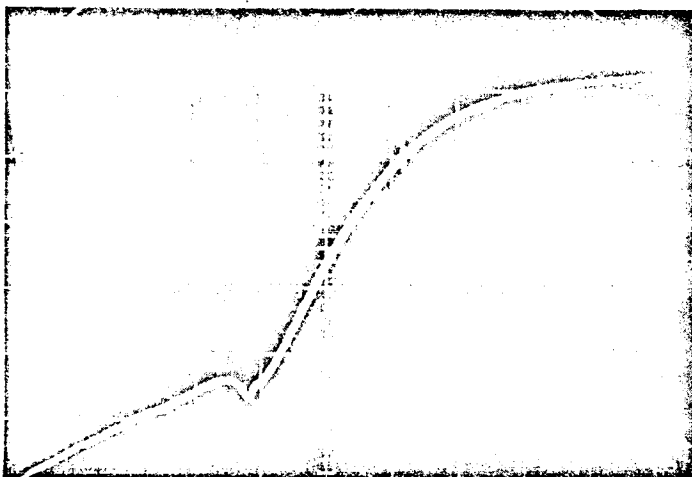
LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.LAB.	PHONE 2061	DATE 11-18-64
PART SE7 25# TCA FUEL VALVE	PART NO. 407560 S/N 4059525	TYPE OF TEST Post Flush Propellant Valve Functional		

REFERENCE: IL 4388-5219 Dated 17 November 1964

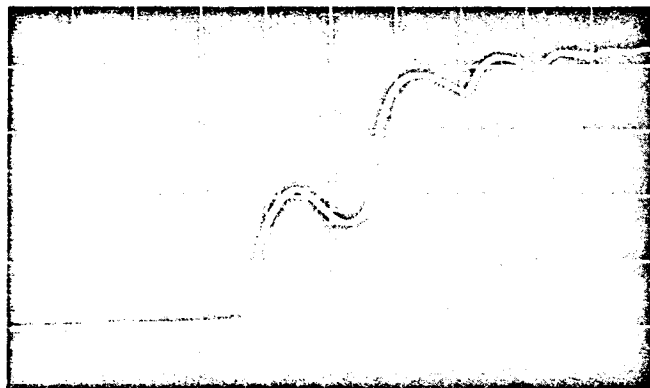
CURRENT TRACE (OPENING TIME)

Horizontal = 1 ms/cm
Vertical = 10 mv/cm
Requirement = 0.0065 sec/max
Actual = 0.0036 sec



VOLTAGE TRACE (CLOSING TIME)

Horizontal = 0.5 ms/cm
Vertical = 10 v/cm
Requirement = 0.0035 sec/max
Actual = 0.0026 sec



ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

INTERNAL LETTER
North American Aviation, Inc.

DATE 23 November 1964

IL 4388-5239

TO Those Concerned
Address

FROM Gemini DAT-RAT Unit
Address D/896-388

SUBJECT SE7 25 lb TCA Unit #1 Oxidizer Propellant Valve,
P/N 407559, S/N 9193579

REFERENCE (a) OFR 12895

An investigation of the reported failure (reference a) of the subject valve during the propellant resistance test indicates a facility malfunction rendered on erroneous representation of the units operability.

It is proposed that the subject unit resume testing upon successful completion of the following:

1. Rebuilding of a new test setup compatible with NTO.
2. Performing propellant valve functionals 6.1, 6.3, 6.4 and 6.5 from DAT specification 208160-401. (Data sheets will be supplied for recording the results.)

R. A. Cole

R. A. Cole
Gemini DAT-RAT Unit

Approved:

R. G. Eide
R. G. Eide
Supervisor
Gemini DAT-RAT Unit

W. Smith 11/23/64
W. Smith
Supervisor
Propellant Valves

J. D. Mavrogenis
J. Mavrogenis
MAC Engineering

Propellant Valve Proof Pressure and Leakage Test
(reference paragraph 6.1)

	Oxidizer Valve
Proof Pressure	
Pressure (500 +10) -0	<u>500</u> psig
Time Duration (3 minimum)	<u>3</u> minutes
Leakage Voltage (26+0.5)	<u>26</u> VDC
Inlet Pressure (500 ±10)	<u>500</u> psig
Time Duration (5 minimum)	<u>5</u> minutes
Leakage Rate (2.23 maximum)	<u>< .1</u> SCC He min
Inspection Remarks	<u>NONE</u>

Propellant Valve Dielectric Strength test (reference paragraph 6.4)

Oxidizer Valve		
Voltage	Current	
Volts	Microamps	
500 ± 10	500 max.	
A to Ground	<u>500</u>	<u>68</u>
C to Ground	<u>500</u>	<u>50</u>
A to C	<u>500</u>	<u>18</u>
Inspection Remarks	<u>NONE</u>	

Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 74 (70±10 F)

Resistance A - B

Oxidizer Valve 41 ohms (Acceptable per Figure 9, yes or no yes)

Resistance C - D
(1.0 maximum)

Oxidizer Valve 128 ohms

Inspection Remarks NONE

Propellant Valve Functional test (reference paragraph 6.5)

Oxidizer Valve

Response Time

Ambient Temperature 68 FEnergizing Voltage 26 VDCInlet Pressure 300 psig(300 \pm 10 for "pull-in")Opening Time 0.039 seconds

(0.0065 maximum)

Inlet Pressure 0 psig

(zero for "drop-out")

Closing Time 0.033 seconds

(0.0035 maximum)

Low Voltage Operation

Ambient Temperature 68 FInlet Pressure 300 psig(300 \pm 10 for "pull-in")Opening Voltage 9 VDC

(16 maximum)

Inlet Pressure 0 psig

(zero for "drop-out")

Closing Voltage 1.8 VDC

(1.0 minimum)

Inspection Remarks NONE

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWB NO. 683369	FACILITY ENV. LAB.	PHONE 2061	DATE 11-23-64
PART SE7 25# TCA Propellant Valve	PART NO. 407559 S/N 9193579	TYPE OF TEST Pre Oxidizer Resistance Functional		

OXIDIZER VALVE

REFERENCE: IL 4388-5239 Dated 23 November 1964

CURRENT TRACE

(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 10 v/cm

Requirement = 0.0065 sec/max

Actual = 0.0039 sec



VOLTAGE TRACE

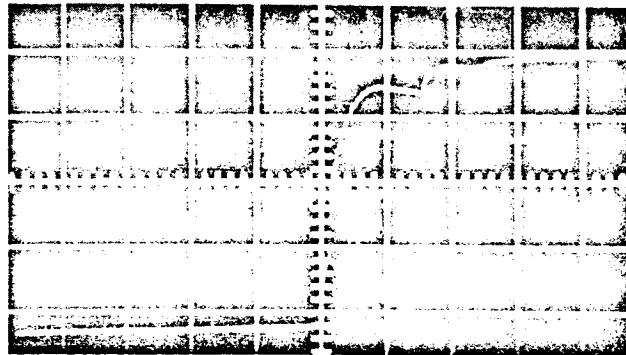
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 Sec/Max

Actual = 0.0033 Sec



ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.13 OF 380

7.1.7.2 Test Data - TCA #1

7.1.7.2.1 Component Identification

Component Name	Oxidizer Valve	Fuel Valve
Rocketdyne Part No.	<u>407559</u>	<u>407560</u>
Component Serial No.	<u>9193579</u>	<u>4059525</u>

7.1.7.2.2 Fuel and Oxidizer Resistance test (reference paragraph 7.1.7.1)

	Oxidizer Valve	Fuel Valve
Start of Exposure (date and time)	<u>11-25-64-10:30 AM</u>	<u>11-23-64-12:30 PM</u>
Environmental Temp. (160 ±5)	<u>160 ±5</u> F	<u>160 ±5</u> F
Propellant Temp. (160 ±5)	<u>160 ±5</u> F	<u>160 ±5</u> F
End of Exposure (date and time)	<u>12-9-64-10:30 AM</u>	<u>12-7-64 1:45 PM</u>

PREPARED BY R. Cole RE 10-31-64	DATE 12/7/64	PERFORMED BY <i>R. Cole</i>	DATE 12-7-64	WITNESSED FOR NAA <i>[Signature]</i>	DATE 12-7-64	CERTIFIED FOR McDONNELL <i>[Signature]</i>	DATE 12-7-64	VERIFIED BY USAF <i>[Signature]</i>	DATE 12-7-64
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FORM 600-B-39 NEW 6-63

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52701-265
NAA 208160-61
 NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.1/ OF 320

7.1.7.2.2

Oxidizer valve actuation checkoff

Date	8AM	4PM	12PM	Date	8AM	4PM	12PM
1 11-25-4				8 12-2-4			
2 11-26-4				9 12-3-4			
3 11-27-4				10 12-4-4			
4 11-28-4				11 12-5-4			
5 11-29-4				12 12-6-4			
6 11-30-4				13 12-7-4			
7 12-1-64				14 12-8-4			
				15 12-9-4			

Fuel Valve actuation checkoff

Date	8AM	4PM	12PM	Date	8AM	4PM	12PM
1 11-23-4				8 12-2-4			
2 11-24-4				9 12-3-4			
3 11-25-4				10 12-4-4			
4 11-26-4				11 12-5-4			
5 11-27-4				12 12-6-4			
6 11-28-4				13 12-7-4			
7 11-29-4				14 12-8-4			
				15 12-9-4			

Inspection Remarks

None 12-9-64

PREPARED BY R. Cole	DATE 10-31-64	PERFORMED BY R. H. May	DATE 12/1/64	WITNESSED FOR NAA L. B. [Signature]	DATE 12-9-64	CERTIFIED FOR McDONNELL [Signature]	DATE 12-9-64
VERIFIED BY USAF [Signature]				DATE 12-9-64			

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUS. CHAMBER ASSEMBLY-25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO 208160-401 SHEET 1 OF 1

Deviation Request:

It is hereby authorized to accept the following deviation to the decontamination procedure for NTO propellant valve S/N 9193579. The deviation occurred during paragraph 7.1.7 1.9 as an apparent obstruction in the facility test setup stopped GN₂ flow. When Freon was introduced there was flow through the propellant valve and the rest of the decontamination was followed.

Recopied from original request dated 9 December 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

12-18-64

R. Cole
R. Cole
Gemini Dat-Rat-Unit

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.15 OF 390

7.1.7.2.3 Propellant Valve Electrical Resistance test (reference paragraph 6.3)

Environmental Temperature 70 (70 ±10F)

Resistance

A - B

Oxidizer Valve 41.3 ohms (Acceptable per Figure 9)
Yes or No YES

Fuel Valve 42.3 ohms (Acceptable per Figure 9)
Yes or No YES

Resistance

C - D

Oxidizer Valve .62 ohms (1.0 maximum)

Fuel Valve .07 ohms

Inspection Remarks

None 12-10-64

PREPARED BY E. Adams <u>EA</u>	DATE <u>4/10/64</u>	PERFORMED BY F. Z. Pope <u>12-10-64</u>	DATE <u>12-10-64</u>	WITNESSED FOR NAA <u>[Signature]</u> <u>12-10-64</u>	DATE <u>12-10-64</u>	CERTIFIED FOR McDONNELL <u>[Signature]</u> VERIFIED BY USAF <u>12-1-64</u>	DATE <u>12-1-64</u>
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FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.16 OF 380

7.1.7.2.4 Propellant Valve Functional Test (reference paragraph 6.5)

Oxidizer Valve Fuel Valve

Response Time

High Temperature

(160 ± 5)

Energizing Voltage

(26 ± 0.5)

Inlet Pressure

(300 ± 10 for "pull-in")

Opening Time

(0.0065 maximum)

Inlet Pressure

(zero for "drop-out")

Closing Time

(0.0035 maximum)

160° F

26 VDC

300 psig

.0050 seconds

ZERO psig

.0030 seconds

160° F

26 VDC

300 psig

.0038 seconds

ZERO psig

.0024 seconds

Low Voltage Operation

High Temperature

(160 ± 5)

Inlet Pressure

(300 ± 10 for "pull-in")

Opening Voltage

(16 maximum)

Inlet Pressure

(zero for "drop-out")

Closing Voltage

(1.0 minimum)

140° F

300 psig

10.5 VDC

ZERO psig

2.5 VDC

160° F

300 psig

7.0 VDC

ZERO psig

1.4 VDC

Inspection Remarks None

PREPARED BY <u>E. Adams</u>	DATE <u>1/10/64</u>	PERFORMED BY <u>F. E. Page</u>	DATE <u>12-10-64</u>	WITNESSED FOR NAA <u>A. [Signature]</u>	DATE <u>1/10/64</u>	CERTIFIED FOR McDONNELL <u>RECEIVED BY [Signature]</u>	DATE <u>1/10/64</u>
VERIFIED BY USAF <u>[Signature]</u>						DATE <u>10 DEC 64</u>	

FORM 608-B-39 NEW 6-63

ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.LAB.	PHONE 2061	DATE 12-10-64
PART SE7 25# TCA Propellant Valve	PART NO. 407559 S/N 9193579	TYPE OF TEST Post Oxidizer Resistance Functional		

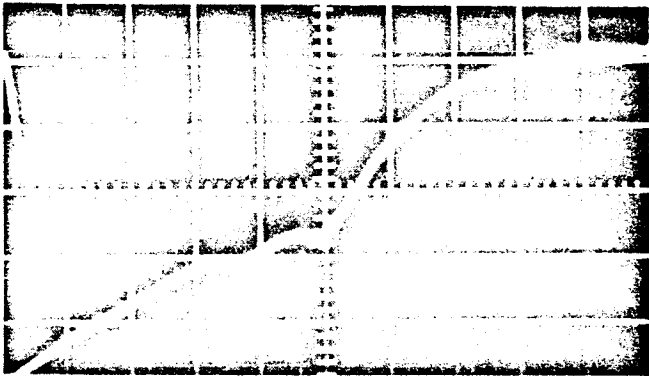
OXIDIZER VALVE

 ENVIRONMENTAL TEMPERATURE 160F

CURRENT TRACE
(OPENING TIME)

Horizontal = 1 ms/cm
Vertical = 10mv/cm

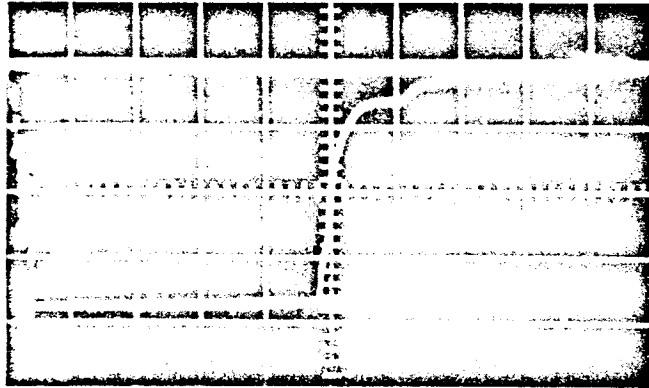
Requirement = 0.0065 sec/max
Actual = 0.0050 sec



VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 0.5 ms/cm
Vertical = 10 mv/cm

Requirement = 0.0035 sec/max
Actual = 0.0030 sec



ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV. LAB	PHONE 2061	DATE 12-10-64
PART SF7 25# TCA Propellant Valve	PART NO. 407560 S/N 4059525	TYPE OF TEST Post Fuel Resistance Functional		

FUEL VALVE

ENVIRONMENTAL TEMPERATURE 16CF

CURRENT TRACE
(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 10mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0038 sec



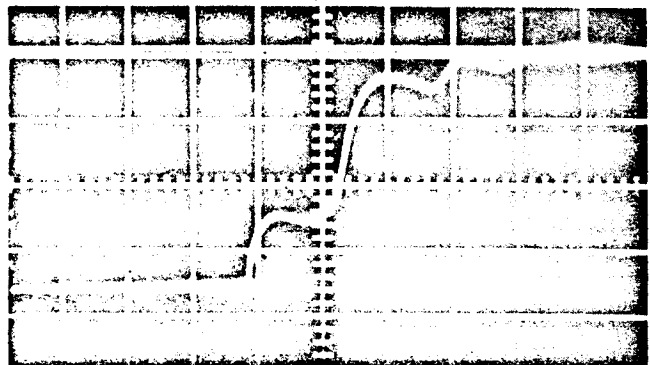
VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0024 sec



DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25H PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.17 OF 380

7.1.7.2.5 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 ± 10	Current Microamps 500 max.	Voltage Volts 500 ± 10	Current Microamps 500 max.
A to Ground	500	71	60	70
C to Ground	500	52		52
A to C	500	17		17
High Temperature (160 ± 5)	60		60	

Inspection Remarks

NONE

PREPARED BY <i>E. Adams</i>	DATE <i>11/10/64</i>	PERFORMED BY <i>F. E. Pope</i>	DATE <i>12-10-64</i>	WITNESSED FOR NAA <i>[Signature]</i>	DATE <i>11/10/64</i>	CERTIFIED FOR McDONNELL <i>[Signature]</i>	DATE <i>11/10/64</i>
				VERIFIED BY USAF <i>[Signature]</i>		DATE <i>1-10-65</i>	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.18 OF 320 D

7.1.7.2.6

Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Proof Pressure
High Temperature (160 \pm 5)
Pressure
(500 \pm 10)

Oxidizer Valve

Fuel Valve

160 F
500 psig

160 F
500 psig

Time Duration
(3 minimum)

3 minutes

3 minutes

Leakage
Voltage (26 \pm 0.5)
Inlet Pressure
(500 \pm 10)

26 VDC
500 psig

26 VDC
500 psig

Time Duration
(5 minimum)

5 minutes

5 minutes

Leakage Rate
(2.23 maximum)

ZERO SCC He
min

ZERO SCC He
min

Inspection Remarks

NONE 19/DEC/64

PREPARED BY <u>E. Adams</u> DATE <u>4/10/64</u>	PERFORMED BY <u>A. Z. [unclear]</u> DATE <u>5/29/64</u>	WITNESSED FOR NAA <u>[unclear]</u> DATE <u>10/Dec/64</u>	CERTIFIED FOR McDONNELL <u>[unclear]</u> DATE <u>12/19/64</u>
VERIFIED BY USAF <u>[unclear]</u>			DATE <u>12/19/64</u>

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25.1 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-01 89.19
SHEET 1 OF 380

7.1.7.2.7.

Propellant Valve Load Analysis Test - Oxidizer Valve
(reference paragraph 6.10)

Oxidizer valve body temp. 160 (160±5) F. (208160-01)

GN₂ supply pressure 300 (300±10) psig. (208160-01)

Power consumption (steady state)

	Current	Voltage	Power
20 VDC	<u>.38</u> (208160-01)	<u>20</u> (208160-01)	<u>7.60</u> (208160-01)
22 VDC	<u>.45</u> (208160-01)	<u>22</u> (208160-01)	<u>9.90</u> (208160-01) (20 watts maximum)
24 VDC	<u>.48</u> (208160-01)	<u>24</u> (208160-01)	<u>11.52</u> (208160-01) (20 watts maximum)
26 VDC	<u>.52</u> (208160-01)	<u>26</u> (208160-01)	<u>13.52</u> (208160-01) (20 watts maximum)
28 VDC	<u>.55</u> (208160-01)	<u>28</u> (208160-01)	<u>15.40</u> (208160-01) (20 watts maximum)
30 VDC	<u>.60</u> (208160-01)	<u>30</u> (208160-01)	<u>18.00</u> (208160-01) (20 watts maximum)
33 VDC	<u>.65</u> (208160-01)	<u>33</u> (208160-01)	<u>21.45</u> (208160-01)

Inspection Remarks

None 12/11/64 (208160-01)

PREPARED BY E. Adams 8/11/64	DATE 12-11-64	PERFORMED BY Claudia Kudzia 12-11-64	DATE 12-11-64	WITNESSED FOR NAA F. H. Hareld 12-11-64	DATE 12-11-64	CERTIFIED FOR McDONNELL V. Swider 12/14/64	DATE 12/14/64
VERIFIED BY USAF 12 DEC 64						DATE 12 DEC 64	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 45 # PART NO. { MAC 52-52701-255
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160 SHEET 401 OF 380 89.2

7.1.7.2.8

Propellant Valve Load Analysis Test-Fuel Valve
(reference paragraph 6.10)

Fuel valve body temp. 160° (160 ±5) F. (AV 165)

GN₂ supply pressure 300 (300 ±10) psig. (AV 165)

Power consumption (steady state)

	Current	Voltage	Power
20 VDC	<u>.38</u> (AV 165)	<u>20</u> (AV 165)	<u>7.60</u> (AV 165)
22 VDC	<u>.42</u> (AV 165)	<u>22</u> (AV 165)	<u>9.24</u> (AV 165) (20 watts maximum)
24 VDC	<u>.45</u> (AV 165)	<u>24</u> (AV 165)	<u>10.80</u> (AV 165) (20 watts maximum)
26 VDC	<u>.50</u> (AV 165)	<u>26</u> (AV 165)	<u>13.00</u> (AV 165) (20 watts maximum)
28 VDC	<u>.55</u> (AV 165)	<u>28</u> (AV 165)	<u>15.40</u> (AV 165) (20 watts maximum)
30 VDC	<u>.60</u> (AV 165)	<u>30</u> (AV 165)	<u>18.00</u> (AV 165) (20 watts maximum)
33 VDC	<u>.65</u> (AV 165)	<u>33</u> (AV 165)	<u>21.45</u> (AV 165)

Inspection Remarks

None 12/11/64 (AV 165)

PREPARED BY <u>E. Adams</u> <u>4/15/64</u> <u>7-10-64</u>	DATE <u>12-11-64</u>	PERFORMED BY <u>Lawrence Kudya</u>	DATE <u>12-11-64</u>	WITNESSED FOR NAA <u>F.H. Hasekhorst</u> <u>12-11-64</u>	DATE <u>12-11-64</u>	CERTIFIED FOR McDONNELL <u>Wagner</u> <u>12/14/64</u>	DATE <u>12/14/64</u>
VERIFIED BY USAF <u>14 DEC 64</u>				DATE <u>14 DEC 64</u>			

FORM 608-B-39 NEW 6-63

R-15019-2

311

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBLER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.22 OF 320

7.1.7.2.10 Propellant Valve Functional Test (reference paragraph 6.5)

	Oxidizer Valve	Fuel Valve
Response Time		
Low Temperature (15 ± 5)	<u>16°</u> F (34/165)	<u>16°</u> F (34/165)
Energizing Voltage (26 ± 0.5)	<u>26</u> VDC (34/165)	<u>26</u> VDC (34/165)
Inlet Pressure (300 ± 10 for "pull-in")	<u>300</u> psig (34/165)	<u>300</u> psig (34/165)
Opening Time (0.0065 maximum)	<u>0.0039</u> seconds (34/165)	<u>0.0034</u> seconds (34/165)
Inlet Pressure (zero for "drop-out")	<u>0</u> psig (34/165)	<u>0</u> psig (34/165)
Closing Time (0.0035 maximum)	<u>0.0052</u> seconds (34/165)	<u>0.0025</u> seconds (34/165)
Low Voltage Operation		
Low Temperature (15 ± 5)	<u>16°</u> F (34/165)	<u>16°</u> F (34/165)
Inlet Pressure (300 ± 10 for "pull-in")	<u>300</u> psig (34/165)	<u>300</u> psig (34/165)
Opening Voltage (16 maximum)	<u>7.7</u> VDC (34/165)	<u>5.2</u> VDC (34/165)
Inlet Pressure (zero for "drop-out")	<u>0</u> psig (34/165)	<u>0</u> psig (34/165)
Closing Voltage (1.0 minimum)	<u>1.57</u> VDC (34/165)	<u>1.0</u> VDC (34/165)
Inspection Remarks	<u>none 12/11/64</u> (34/165)	

PREPARED BY E. Adams <i>E.A.</i>	DATE <u>4/10/64</u>	PERFORMED BY Clarence Kudzia	DATE <u>12-11-64</u>	WITNESSED FOR NAA F. N. Haselkorn <u>12/11/64</u>	DATE <u>12/11/64</u>	CERTIFIED FOR McDONNELL J. Snider <u>12/14/64</u>	DATE <u>12/14/64</u>
				VERIFIED BY USAF		DATE <u>14 DEC 64</u>	

FORM 608-B-39 NEW 6-63

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.LAB.	PHONE 2061	DATE 12-11-64
PART SE7 25# TCA Propellant Valve	PART NO. 407559 S/N 9193579	TYPE OF TEST Post Oxidizer Resistance Functional		

OXIDIZER VALVE

ENVIRONMENTAL TEMPERATURE 15F

CURRENT TRACE

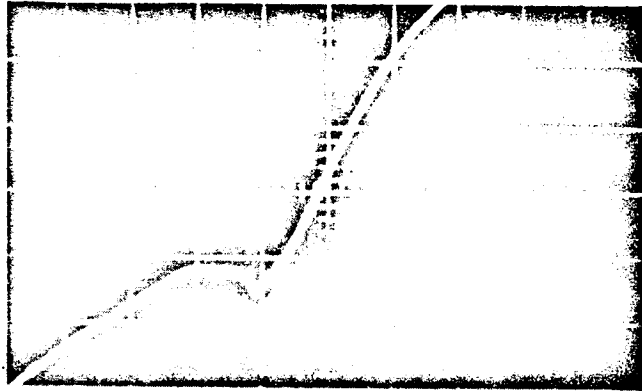
(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 10mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0039 sec



VOLTAGE TRACE

(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0032 sec



ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY F. Pope	EWR NO. 595396	FACILITY ENV.LAB.	PHONE 2061	DATE 12-11-64
PART SE7 25# TCA Propellant Valve	PART NO. 407560 S/N 4059525	TYPE OF TEST Post Fuel Resistance Functional		

FUEL VALVE

ENVIRONMENTAL TEMPERATURE 15F

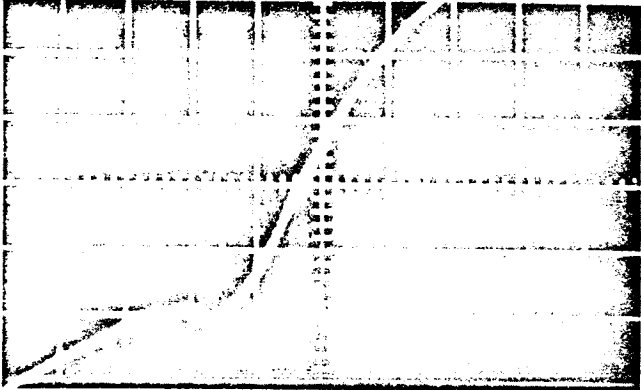
CURRENT TRACE
(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 10 mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0034 sec



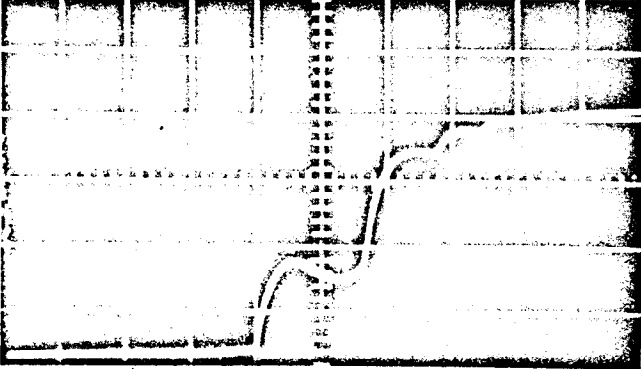
VOLTAGE TRACE
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 10 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0025 sec



**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25// PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.23 OF 380

D

7.1.7.2.11 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 \pm 10	Current Microamps 500 max.	Voltage Volts 500 \pm 10	Current Microamps 500 max.
A to Ground	500	58	500	76
C to Ground	500	61	500	69
A to C	500	36	500	16
Low Temperature (15 \pm 2)	162	F	162	F
Inspection Remarks				

none 12/11/64

PREPARED BY <i>E. Adams</i>	DATE <i>11/10/64</i>	PERFORMED BY <i>Clarence Sledge</i>	DATE <i>12-11-64</i>	WITNESSED FOR NAA <i>F. H. Hancherson</i>	DATE <i>12/11/64</i>	CERTIFIED FOR McDONNELL <i>W. Snider</i>	DATE <i>12/14/64</i>
				VERIFIED BY USAF		DATE <i>14 DEC 64</i>	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25// PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401 SHEET 89.24 OF 280

7.1.7.2.12 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

Proof Pressure
High Temperature (157 \pm 5)
Pressure
(500 \pm 10)

Oxidizer Valve

Fuel Valve

162 F
500 psig

162 F
500 psig

Time Duration
(3 minimum)

3 minut

3 minutes

Leakage
Voltage (26 \pm 0.5)
Inlet Pressure
(500 \pm 10)

26 VDC
500 psig

26 VDC
500 psig

Time Duration
(5 minimum)

5 minut

5 minutes

Leakage Rate
(2.23 maximum)

0 SCC He
min

0 SCC He
min

Inspection Remarks

none 12/11/64

PREPARED BY <u>E. Adams</u> DATE <u>4/10/64</u>	PERFORMED BY <u>Clarence K. Gudge</u> DATE <u>12-11-64</u>	WITNESSED FOR NAA <u>F. H. Havelhorst</u> DATE <u>12/11/64</u>	CERTIFIED FOR McDONNELL <u>W. J. Smith</u> DATE <u>12/14/64</u> VERIFIED BY USAF <u>14 DEC 64</u>
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FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401-89.3 SHEET OF 320

- Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20
- 7.1.8 Disassembly and Inspection of Propellant Valves
- 7.1.8.1 Test Procedure
- 7.1.8.1.1 Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407664 shall not be removed at this time.
- 7.1.8.1.2 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish this shall be removed. The filter assembly P/N KA5-28097-17 shall not be removed at this time.
- 7.1.8.1.3 Remove, bag and identify the seat assembly.
- 7.1.8.1.4 Remove, bag and identify the armature P/N 407569.
- 7.1.8.1.5 Remove, bag and identify the spring P/N 406806.
- 7.1.8.1.6 Remove, bag and identify the filter assembly.
- 7.1.8.1.7 Bag and identify the solenoid assembly.
- 7.1.8.1.8 Repeat 7.1.8.1 through 7.1.8.1.7 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY: R.Cole	DATE <i>RC</i>	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE	<i>[Signature]</i> 12-28-64			
<i>J. A. Sanger</i> 12/28/64					

FORM 608-B-38 NEW 6-63

Rev. *J. D. McVey* 12/28/64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-701 8904 SHEET 1 OF 320

7.1.8.2 Post Test Inspection

7.1.8.2.1 Component Identification

	Oxidizer Valve	Fuel Valve
P/N	<u>407559</u>	<u>407560</u>
S/N	<u>9193579</u>	<u>4059525</u>

7.1.8.2.2 Disassembly of Propellant Valves (Reference: Paragraphs 7.1.8.1.1 through 7.1.8.1.8)

The propellant valves were disassembled and all parts called for were bagged and identified. (Yes or No)

Inspection Remarks: NO VISIBLE DAMAGE OTHER THAN THAT CAUSED BY DISASSEMBLY

PREPARED BY R.Cole <i>RC</i>	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL BY J. SNYDER 7/16/65 VERIFIED BY USAF 7/16/65
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FORM 608-B-39 NEW 6-63

Rev.D *J.D. Marry* Date 12/28/64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208160-401 SHEET 90 OF 380

Reference: MAC SCD 52-52701, Revision F, Figure 12

7.2 Thrust Chamber Assembly Number 2

This subsection specifies the tests which are to be performed on Thrust Chamber Assembly No. 2.

PREPARED BY: <u>E. Adams</u> <u>HA</u> DATE <u>4/10/64</u>	APPROVED FOR NAA: <u>R. Eide</u> DATE <u>4-13-64</u>	APPROVED FOR McDONNELL: _____ DATE _____
CHECKED BY: <u>7/1/64</u> DATE <u>9.10.64</u>		

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-SHEET 91 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.2.1

7.2.1 Pre-Test Inspection - TCA #2

7.2.1.1 Test Procedure

7.2.1.1.1 Verify that the TCA is of the proper configuration and has passed the Acceptance Test of Rocketdyne specification RAO220-354. Only the TCA's that comply with the above requirement shall be accepted for DAT.

7.2.1.1.2 Record the Rocketdyne Part Number and Serial Number of the TCA.

7.2.1.1.3 Record the Rocketdyne Part Number and Serial Number of the oxidizer propellant valve.

7.2.1.1.4 Record the Rocketdyne Part Number and Serial Number of the fuel propellant valve.

7.2.1.1.5 Record the McDonnell Part Number of the TCA.

7.2.1.1.6 Inspect the TCA for visual evidence of damage or deterioration. Comment on all visual defects.

7.2.1.1.7 Braze propellant valve inlet adapters to the fuel and oxidizer inlet tube stubs as defined in Rocketdyne Process Specification RAO607-009.

7.2.1.1.8 Perform Weight Determination of paragraph 6.6.

PREPARED BY: E. Adams	DATE 4/10/64	APPROVED FOR NAA:	DATE 4-13-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: J. H. [Signature]	DATE 4-13-64	[Signature]			

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-401 SHEET 92 OF 380

7.2.1.2 Test Data - TCA #2

7.2.1.2.1 Component Identification

		Oxidizer	Fuel
Component Name	TCA	Valve	Valve

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61 407559 407560

Component Serial No. 4052232 4054460 4055162

7.2.1.2.2 Inspection (Reference paragraph 7.2.1.1)

7.2.1.2.2.1 The TCA was inspected and found to be of the proper configuration and had passed the acceptance tests of RAO 220-354. YES
(Yes or No).

7.2.1.2.2.2 Propellant valve inlet adapters were installed on the propellant valves per paragraph 7.2.1.1.7 YES (Yes or No).

7.2.1.2.2.3 Inspection Remarks

NONE

PREPARED BY <u>E. Adams</u>	DATE <u>4/12/64</u>	PERFORMED BY <u>M.P. [Signature]</u>	DATE <u>4/12/64</u>	WITNESSED FOR NAA <u>Guine Frucioni</u>	DATE <u>4/12/64</u>	CERTIFIED FOR McDONNELL <u>A.D. Narroenis</u>	DATE <u>12/16/64</u>
				VERIFIED BY, USAF <u>[Signature]</u>		DATE <u>5/18/64</u>	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-5101-265
NAA 208100-61
NAME OF TEST PRE-TEST INSPECTION TEST NO 208160 SHEET 92 OF 90

7.2.2.2.3 Weight Determination Test Data (reference paragraph 6.6)

All protective closures were removed from the TCA.

Yes (Yes or No)

The TCA dry weight was 3.15 pounds.
(Record to the nearest one-hundredth pound)

Inspection Remarks

NONE

PREPARED BY <u>E. Adams</u>	DATE <u>4/15/64</u>	PERFORMED BY <u>F. R. Pope</u>	DATE <u>8-20-64</u>	WITNESSED FOR NAA <u>E. Marchionni</u>	DATE <u>8-20-64</u>	CERTIFIED FOR McDONNELL <u>J. D. Marregans</u>	DATE <u>12/16/64</u>
VERIFIED BY USAF <u>R. R. [unclear]</u>						DATE <u>8-20-64</u>	

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-401 SHEET 94 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.3.7

7.2.2 Temperature Shock - TCA #2

7.2.2.1 Test Procedure

7.2.2.1.1 Place the TCA unit in a temperature chamber maintained at a temperature of $185 \pm 5^{\circ}\text{F}$.

7.2.2.1.2 Expose the TCA to $185 \pm 5^{\circ}\text{F}$ for a continuous period of four hours minimum.

7.2.2.1.3 Transfer the TCA unit to a temperature chamber maintained at a temperature of $-40 \pm 5^{\circ}\text{F}$.
NOTE: Throughout the temperature shock testing the transfer of the TCA from one temperature chamber to another shall be accomplished within a maximum time limit of five minutes.

7.2.2.1.4 Expose the TCA unit to $-40 \pm 5^{\circ}\text{F}$ for a continuous period of four hours minimum.

7.2.2.1.5 Repeat paragraphs 7.2.2.1.1 through 7.2.2.1.4 two more times.

7.2.2.1.6 Allow the TCA unit to return to room ambient temperature.

7.2.2.1.7 Within one hour, following stabilization of the TCA's temperature, begin the first of the following procedures. The tests shall be carried through to completion without delay. In the event of a structural failure see paragraph 3.6.

7.2.2.1.7.1 Perform Propellant Valve Proof Pressure and Leakage Test per paragraph 6.1.

7.2.2.1.7.2 Perform Thrust Chamber Proof Pressure and Leakage Test per paragraph 6.2.

PREPARED BY: E. Adams	DATE 4/10/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE				

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-401 SHEET 95 OF 380

- 7.2.2.1.7.3 Perform Propellant Valve Electrical Resistance Test per paragraph 6.3.
- 7.2.2.1.7.4 Perform Propellant Valve Dielectric Strength Test per paragraph 6.4.
- 7.2.2.1.7.5 Perform Propellant Valve Functional Test per paragraph 6.5.

PREPARED BY: <u>Ed</u> DATE <u>4/10/64</u>	APPROVED FOR NAA: <u>[Signature]</u> DATE <u>4-13-64</u>	APPROVED FOR McDONNELL: <u>[X]</u> DATE <u> </u>
CHECKED BY: <u>[Signature]</u> DATE <u>4-10-64</u>		

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-401 SHEET 96 OF 380

7.2.2.2 Test Data - TCA #2

7.2.2.2.1 Component Identification

Component Name TCA

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058232

7.2.2.2.2 Temperature Shock Test (reference paragraph 7.2.2.1)

7.2.2.2.2.1 The TCA was placed in a temperature chamber where it was exposed to a temperature of 185 (185 +5F) for a time period of 4 (4 minimum) hours. START AT 2:10 PM. 8-20-64
OUT AT 6:10 PM

7.2.2.2.2.2 The TCA was transferred to a temperature chamber where it was exposed to a temperature of -40 F (-40 +5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) START AT 6:10 PM. 8-20-64

7.2.2.2.2.3 The TCA was transferred to a temperature chamber where it was exposed to a temperature of 185 F (185 +5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) 10:13 START TIME 8-20-64

7.2.2.2.2.4 The TCA was transferred to a temperature chamber where it was exposed to a temperature of -40 F (-40 +5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) 2:14 START TIME 8-21-64

PREPARED BY <u>E. Adams</u> <u>et</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>H. E. Boye</u> <u>8-21-64</u>	DATE <u>8-21-64</u>	WITNESSED FOR NAA <u>G. Taylor</u> <u>8-21-64</u>	DATE <u>8-21-64</u>	CERTIFIED FOR McDONNELL <u>G. L. Egan</u> <u>8-22-64</u>	DATE <u>8-22-64</u>
						VERIFIED BY USAF <u>W. B. Ballester</u> <u>8/21/64</u>	DATE <u>8-21-64</u>

FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
401
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160- SHEET 97 OF 380

- START TIME 6:17 AM 8-21-64
- 7.2.2.2.2.5 The TCA was transferred to a temperature chamber where it was exposed to a temperature of 185 F (185 +5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No) STOP @ 10:27
- START @ 10:28
- 7.2.2.2.2.6 The TCA was transferred to a temperature chamber where it was exposed to a temperature of -40 F (-40 +5F) for a time period of 4 (4 minimum) hours. Transfer time was less than five minutes. YES (Yes or No)
- STOP @ 2:15 PM 8-21-64
- 7.2.2.2.2.7 Inspection Remarks

NONE













PREPARED BY E. Adams <i>gt</i> 4/10/64	DATE 4/10/64	PERFORMED BY F. J. Vose 8-21-64	DATE 8-21-64	WITNESSED FOR NAA <i>[Signature]</i> 8-21-64	DATE 8-21-64	CERTIFIED FOR McDONNELL D. L. Gann 8-22-64 VERIFIED BY USAF C. K. Brown 8/21/64	DATE 8/21/64
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FORM 608-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 203160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 203160-401 SHEET 98 OF 380

7.2.2.2.3 Propellant Valve Proof Pressure and Leakage test (reference paragraph 6.1)

	Oxidizer Valve	Fuel Valve
Proof Pressure		
Pressure (500 \pm 10)	 <u>500</u> psig	 <u>500</u> psig
Time Duration (3 minimum)	 <u>3</u> minutes	 <u>3</u> minutes
Leakage Voltage (26 \pm 0.5)	 <u>26</u> VDC	 <u>26</u> VDC
Inlet Pressure (500 \pm 10)	 <u>500</u> psig	 <u>500</u> psig
Time Duration (5 minimum)	 <u>5</u> minutes	 <u>5</u> minutes
Leakage Rate (2.23 maximum)	 <u>ZERO</u> SCC He <u>5</u> min	 <u>< 0.1</u> SCC He <u>6</u> min
Inspection Remarks	<u>NONE</u>	

PREPARED BY <u>E. Adams</u> DATE <u>4/10/64</u>	PERFORMED BY <u>F. J. Pope</u> DATE <u>2-21-64</u>	WITNESSED FOR NAA <u>J. J. Murdoch</u> DATE <u>8/21/64</u>	CERTIFIED FOR McDONNELL <u>E. J. Green</u> DATE <u>8-22-64</u>
		VERIFIED BY USAF <u>E. J. Green</u> DATE <u>8/21/64</u>	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-101 SHEET 99 OF 380

7.2.2.2.4 Thrust Chamber Proof Pressure and Leakage test (reference paragraph 6.2)

Proof Pressure

Pressure
(392 \pm 10)

1st Application
392 psig

2nd Application
392 psig

Time Duration
(3 \pm 0.25)

3 minutes

3 minutes

Voltage (12 \pm 2.0)

12 VDC

12 VDC

Inspection Remarks

NO EVIDENCE OF

LEAKAGE

PREPARED BY E. Adams <i>et</i>	DATE 9/10/64	PERFORMED BY Z Z Pope 8-21-64	DATE 8-21-64	WITNESSED FOR NAA <i>J. F. McQuinn</i>	DATE 8-21-64	CERTIFIED FOR McDONNELL <i>D. J. Gamm</i>	DATE 8-22-64
						VERIFIED BY USAF <i>E. J. Gamm</i>	DATE 8/31/64

FORM 608-B-39 NEW 6-63

R-15019-2

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-401 SHEET 101 OF 380

7.2.2.2.6 Propellant Valve Dielectric Strength Test (reference paragraph 6.4)

	Oxidizer Valve		Fuel Valve	
	Voltage Volts 500 ± 10	Current Microamps 500 max.	Voltage Volts 500 ± 10	Current Microamps 500 max.
A to Ground	500	62	500	64
C to Ground	500	50	500	49
A to C	500	15	500	18

Inspection Remarks

None

PREPARED BY <i>EA</i> E. Adams	DATE <i>11/10/64</i>	PERFORMED BY <i>J. Sally</i>	DATE <i>8-21-64</i>	WITNESSED FOR NAA <i>J.F. Murckison</i>	DATE <i>8-21-64</i>	CERTIFIED FOR McDONNELL <i>G. J. Gann</i>	DATE <i>8-22-64</i>
				VERIFIED BY USAF <i>G. J. Gann</i>	DATE <i>8/21/64</i>		

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
701
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-SHEET OF 401

Deviation Request:

Due to lack of zener diode, ran functional test
(paragraph 6.5) without a diode for closing response
time for Unit #2.

Recopied from original request dated 21 August 1964.

J. D. Marregenis for
L.L. Gann
MAC Engineering

R.A. Cole

R.A. Cole
Gemini DAT-RAT Unit

12-21-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST TEMPERATURE SHOCK TEST NO. 208160-401 SHEET 102 OF 380

7.2.2.2.7 Propellant Valve Functional Test (reference paragraph 6.5)

Oxidizer Valve Fuel Valve

Response Time

Ambient Temperature
(70 ±10)

Energizing Voltage
(26 ±0.5)

Inlet Pressure
(300 ±10 for "pull-in")

Opening Time
(0.0065 maximum)

Inlet Pressure
(zero for "drop-out")

Closing Time
(0.0035 maximum)

	<u>70</u> F		<u>70</u> F
	<u>26</u> VDC		<u>26</u> VDC
	<u>300</u> psig		<u>300</u> psig
	<u>.0040</u> seconds		<u>.0038</u> seconds
	<u>0</u> psig		<u>0</u> psig
	<u>.0018</u> seconds		<u>.0017</u> seconds

Low Voltage Operation

Ambient Temperature
(70 ±10)

Inlet Pressure
(300 ±10 for "pull-in")

Opening Voltage
(16 maximum)

Inlet Pressure
(zero for "drop-out")

Closing Voltage
(1.0 minimum)

	<u>70</u> F		<u>70</u> F
	<u>300</u> psig		<u>300</u> psig
	<u>7.5</u> VDC		<u>6</u> VDC
	<u>0</u> psig		<u>0</u> psig
	<u>1.2</u> VDC		<u>1.25</u> VDC

Inspection Remarks Test completed without Zener

Diode Per Figure 4

PREPARED BY E. Adams <i>E.A.</i>	DATE <u>8-21-64</u>	PERFORMED BY <i>J. Sally</i>	DATE <u>8-21-64</u>	WITNESSED FOR NAA <i>J. H. Murchison</i>	DATE <u>8-21-64</u>	CERTIFIED FOR McDONNELL <i>D. L. Martin</i>	DATE <u>8-22-64</u>
				VERIFIED BY USAF <i>[Signature]</i>			

FORM 608-B-39 NEW 6-63

PREPARED BY J.Lally	EWR NO. 595396	FACILITY ENV.LAB.C.P.	PHONE 2061	DATE 8-21-64
PART SE7 25# TCA Unit #2	PART NO. 208160-61 S/N 4058232	TYPE OF TEST POST TEMPERATURE SHOCK FUNCTIONAL		

OKIDIZER VALVE

P/N 407559

S/N 4054460

CURRENT TRACE

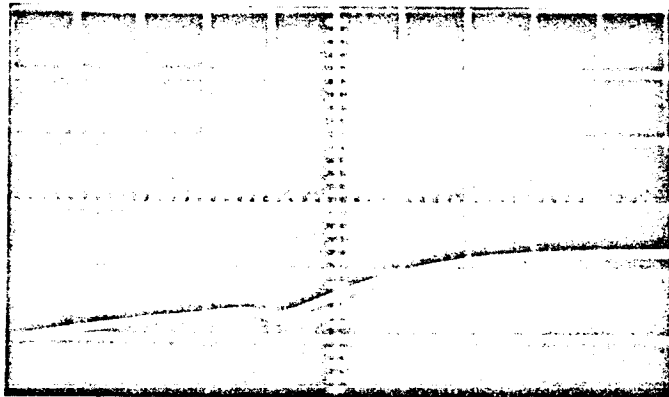
(OPENING TIME)

Horizontal = 1 ms/cm

Vertical = 50 mv/cm

Requirement = 0.0065 sec/max

Actual = 0.0040 sec



VOLTAGE TRACE

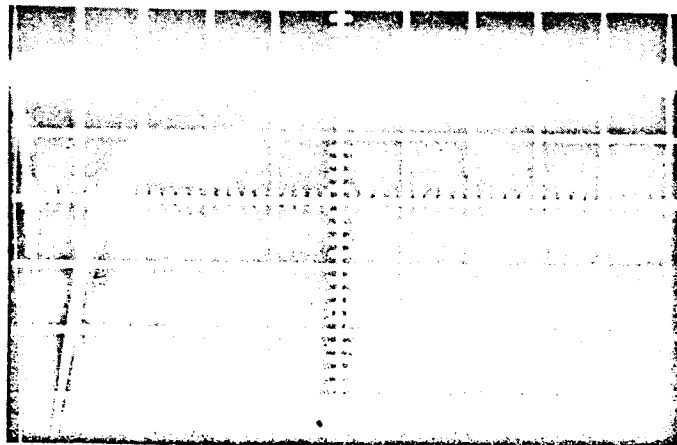
(CLOSING TIME)

Horizontal = 0.5 ms/cm

Vertical = 20 v/cm

Requirement = 0.0035 sec/max

Actual = 0.0018 sec



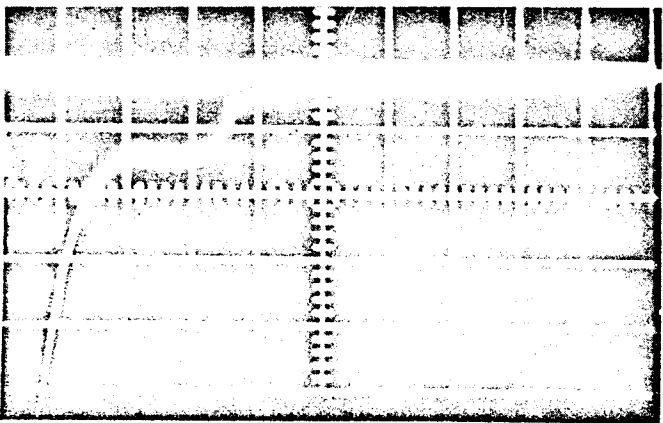
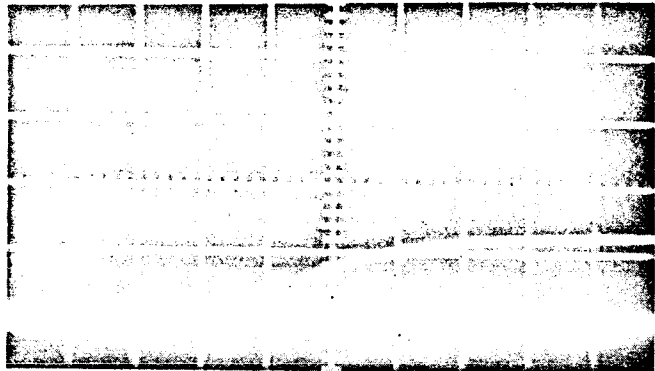
ROCKETDYNE

DEVELOPMENT LABORATORY TEST REPORT

PAGE _____ OF _____

LAB TEST NO. _____

PREPARED BY J. Lally	EWR NO. 595396	FACILITY ENV.LAB CP
PHONE 2061	DATE 8-21-64	
PART SE7 25# TCA Unit #2	PART NO. 208160-61 S/N 4058232	TYPE OF TEST Post Temperature Shock Functional
FUEL VALVE		
P/N 407560 S/N4055162		
CURRENT TRACE (OPENING TIME)		
Horizontal = 1 ms/cm Vertical = 50mv/cm		
Requirement = 0.0065 sec/max Actual = 0.0038 sec		
VOLTAGE TRACE (CLOSING TIME)		
Horizontal = 0.5 ms/cm Vertical = 20 v/cm		
Requirement = 0.0035 sec/max Actual = 0.0017 sec		



DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-107 SHEET 103 OF 380

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

7.2.3 Impulse Signal Width - TCA #2

7.2.3.1 Test Procedure

7.2.3.1.1 Nominal Pulse Width

✓ 7.2.3.1.1.1 Install the TCA in the pulsing test fixture and insure that all connections are properly secured. ✓

✓ 7.2.3.1.1.2 Visually inspect the propellant feed system for possible leaks. ✓

7.2.3.1.1.3 Adjust the propellant tank pressurizing system to obtain TCA design nominal inlet pressures specified in Paragraph 6.7.

7.2.3.1.1.4 Activate the altitude chamber to attain and maintain a simulated pressure altitude of 100,000 feet or greater.

7.2.3.1.1.5 Establish a valve energizing voltage of 26 ± 1 VDC.

7.2.3.1.1.6 Adjust the TCA electrical control system to fire one (1) 2.5 second continuous pulse.

NOTE: Use procedures outlined in the operations manual of Paragraph 2.3.

7.2.3.1.1.7 Start Recording instrumentation.

7.2.3.1.1.8 Energize both TCA propellant valves simultaneously to fire the TCA for the pulse duration set in Paragraph 7.2.3.1.1.6

7.2.3.1.1.9 De-energize both propellant valves simultaneously.

PREPARED BY: <u>E. Adams</u> DATE <u>10-26-64</u>	APPROVED FOR NAA: <u>[Signature]</u> DATE <u>11-23-64</u>	APPROVED FOR McDONNELL: <u>[X]</u> DATE <u>[X]</u>
CHECKED BY: <u>[Signature]</u> DATE <u>11-20-64</u>		

FORM 608-B-38 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-101 SHEET 104 OF 380

- 7.2.3.1.1.10) Stop recording instrumentation. AC 2204
- 7.2.3.1.1.11) Adjust the TCA electrical control system to fire 20 pulses of 11 milliseconds duration at 3 second periods. AC 2204
- 7.2.3.1.1.12) Start recording instrumentation. AC 2204
- 7.2.3.1.1.13) Fire pulse sequence. AC 2204
- 7.2.3.1.1.14) Stop recording instrumentation. AC 2204
- 7.2.3.1.1.15) Repeat steps 7.2.3.1.1.12 through 7.2.3.1.1.14 for 20 pulses of 15 milliseconds duration at 3 second periods. AC 2204
- 7.2.3.1.1.16) Repeat steps 7.2.3.1.1.12 through 7.2.3.1.1.14 for 20 pulses of 20 millisecond duration at 3 second periods. AC 2204
- 7.2.3.1.1.17) Repeat steps 7.2.3.1.1.12 through 7.2.3.1.1.14 for 20 pulses of 30 milliseconds duration at 3 second periods. AC 2204
- 7.2.3.1.1.18) Repeat steps 7.2.3.1.1.12 through 7.2.3.1.1.14 for 20 pulses of 50 millisecond duration at 3 second periods. AC 2204
- 7.2.3.1.1.19) Repeat steps 7.2.3.1.1.12 through 7.2.3.1.1.14 for 20 pulses at 100 millisecond duration at 3 second periods. AC 2204
- 7.2.3.1.1.20) Discontinue testing and remove TCA from test stand per paragraph 6.7.
- 7.2.3.1.1.21) Perform decontamination per paragraph 6.8. AC 2204
- 7.2.3.1.1.22) Reduce data per SEM 4388-1040 to determine pulse width required for MIP of 0.25 lb. SEC total impulse.

PREPARED BY: R. Cole	DATE 11-20-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 11-23-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>[Signature]</i>	DATE 11-20-64				

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 105 OF 380

- 7.2.3.1.2. Pulse Repeatability Test (Room Temperature)
- 7.2.3.1.2.1 Prepare facility for testing per paragraph 7.2.3.1.1.1 through 7.2.3.1.1.10.
- 7.2.3.1.2.2 Conduct 20 pulses of the pulse width calculated in paragraph 7.2.3.1.1.22 with a minimum pulse period of three (3) seconds.
- 7.2.3.1.2.3 Establish a valve energizing voltage of 22 ± 1 VDC.
- 7.2.3.1.2.4 Conduct 20 pulses per paragraph 7.2.3.1.2.2.
- 7.2.3.1.2.5 Establish a valve energizing voltage of 30 ± 1 VDC.
- 7.2.3.1.2.6 Conduct 20 pulses per paragraph 7.2.3.1.2.2.
- 7.2.3.1.2.7 Discontinue testing.
- 7.2.3.1.2.8 Review all raw test data to verify satisfactory quality of all recorded data.
- 7.2.3.1.2.9 Reduce data per SEM 4388-4040.
- 7.2.3.1.3 Pulse Repeatability Test (High Temperature)
- 7.2.3.1.3.1 Install Iron-Constantan thermocouples on the TCA inlets and the TCA injector manifold.
- 7.2.3.1.3.2 Install provisions for heating the propellants and the TCA injector to 160 ± 5 F.
- 7.2.3.1.3.3 Prepare facility for testing per paragraph 7.2.3.1.1.1 through 7.2.3.1.1.5.

PREPARED BY: J. A. Ganger	DATE 1-9-65	APPROVED FOR NAA: <i>[Signature]</i>	DATE 1-9-65	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE 1-9-65
CHECKED BY: <i>[Signature]</i>	DATE 1-9-65				

FORM 608-B-38 NEW 6-63

REVISION *[Signature]* DATED 1-9-65

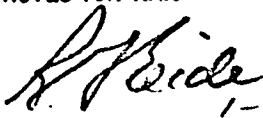

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
208160-401 106 380
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 106 OF 380

- 7.2.3.1.3.4 Heat the propellants and the TCA injector to 160 ± 5 F.
- 7.2.3.1.3.5 Conduct 20 pulses of the pulse width calculated in paragraph 7.2.3.1.1.22 with a minimum pulse period of three (3) seconds.
- 7.2.3.1.3.6 Establish a valve energizing voltage of 22 ± 1 VDC.
- 7.2.3.1.3.7 Verify that the propellants and the TCA injector temperature are 160 ± 5 F.
- 7.2.3.1.3.8 Conduct 20 pulses per paragraph 7.2.3.1.3.5.
- 7.2.3.1.3.9 Establish a valve energizing voltage of 30 ± 1 VDC.
- 7.2.3.1.3.10 Verify that the propellants and the TCA injector temperatures are 160 ± 5 F.
- 7.2.3.1.3.11 Conduct 20 pulses per paragraph 7.2.3.1.3.5.
- 7.2.3.1.3.12 Perform a verification test per paragraph 7.2.3.1.1.5 through 7.2.3.1.1.10.
- 7.2.3.1.3.13 Discontinue testing.
- 7.2.3.1.3.14 Review all raw test data to verify satisfactory quality of all recorded data.
- 7.2.3.1.3.15 Reduce data per SEM 4388-4040.
- 7.2.3.1.4 Pulse Repeatability Test (Low Temperature)
- 7.2.3.1.4.1✓ Install Iron-Constantan thermocouples on the TCA inlets and the TCA injector manifold.

PREPARED BY: J. Ganger	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY:	DATE	 1-9-65		 1-9-65	

FORM 608-B-38 NEW 6-63

Rev. D  Date 1-9-65

R-15019-2

339

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME <u>THRUST CHAMBER ASSEMBLY - 25#</u>	PART NO. {	MAC <u>52-52701-265</u>
		NAA <u>208160-61</u>
NAME OF TEST <u>IMPULSE SIGNAL WIDTH</u>	TEST NO. <u>208160-101</u>	SHEET <u>107</u> OF <u>380</u>

- | | | |
|--------------|---|---|
| 7.2.3.1.4.2 | Install provisions for cooling the propellants and the TCA injector to 20 \pm 5 F. | D |
| 7.2.3.1.4.3 | Prepare facility for testing per paragraph 7.2.3.1.1.1 through 7.2.3.1.1.5. | |
| 7.2.3.1.4.4 | Cool the propellants and the TCA injector to 20 \pm 5 F. | D |
| 7.2.3.1.4.5 | Conduct 20 pulses of the pulse width calculated in paragraph 7.2.3.1.1.22 with a minimum pulse period of three (3) seconds. | D |
| 7.2.3.1.4.6 | Establish a valve energizing voltage of 22 \pm 1 VDC. | |
| 7.2.3.1.4.7 | Verify that the propellants and the TCA injector temperatures are 20 \pm 5 F. | D |
| 7.2.3.1.4.8 | Conduct 20 pulses per paragraph 7.2.3.1.4.5. | |
| 7.2.3.1.4.9 | Establish a valve energizing voltage fo 30 \pm 1 VDC. | |
| 7.2.3.1.4.10 | Verify that the propellants and the TCA injector temperatures are 20 \pm 5 F. | D |
| 7.2.3.1.4.11 | Conduct 20 pulses per paragraph 7.2.3.1.4.5. | |
| 7.2.3.1.4.12 | Perform a verification test per paragraph 7.2.3.1.1.5, through 7.2.3.1.1.10. | |
| 7.2.3.1.4.13 | Shut down facility per paragraph 7.2.3.1.1.20 and 7.2.3.1.1.21. | |
| 7.2.3.1.4.14 | Reduce data per SEM 4388-4040. | |

NOTE: Impulse Signal Width Tests are conducted primarily for information purposes and failure to pass this test does not constitute a failure of the TCA.

PREPARED BY: J. Ganger	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>[Signature]</i>	DATE 1-9-65	<i>[Signature]</i>	1-9-65	<div style="border: 1px solid black; width: 100px; height: 100px; margin: 0 auto; position: relative;"> <div style="position: absolute; top: 0; left: 0; right: 0; bottom: 0; border: 1px solid black; transform: rotate(45deg); transform-origin: center;"></div> <div style="position: absolute; top: 0; right: 0; left: 0; bottom: 0; border: 1px solid black; transform: rotate(-45deg); transform-origin: center;"></div> </div>	

FORM 608-B-38 NEW 6-63

Rev. D *[Signature]* Date 1-9-65

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 4388-5309

INTERNAL LETTER

North American Aviation, Inc.

DATE 30 December 1964

TO Those Concerned
Address

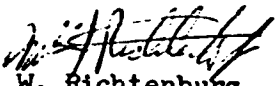
FROM Gemini DAT-RAT Unit
Address D/896-388

SUBJECT Deviation to Specification 208160-401, Design Approval
Testing - 25 lb OAMS TCA, P/N 208160-61

This IL authorizes the use of facility verification tests prior to a hot fire test series. This verification, while not a requirement, may be conducted provided:

1. The test(s) duration does not exceed 3 seconds.
2. At least 45 minutes are allowed to pass prior to further testing.

Results of the verification test, if conducted, are to be approved by the cognizant Gemini DAT Development Engineer prior to future testing.


W. Richtenburg
Gemini DAT-RAT Unit

Approved: 
J. Mavrogenis
MAC Engineering

12-30-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-701 SHEET 11 OF 380

7.2.3.2 Test Data - TCA # 2

7.2.3.2.1 Component Identification

Component Name

TCA

McDonnell Part No.

52-52701-265

Rocketdyne Part No.

208160-61

Component Serial No.

4058232

Accumulated Acceptance Test Firing Time, seconds

7.02

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pre-Test	Post Test
<u>.3574</u>	<u>.3578</u>
<u>2.230</u>	<u>2.242</u>

7.2.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	<u>24 Nov 64</u>	<u>24 Nov 64</u>
Sample Batch Number	<u>11-282</u>	<u>11-292</u>
Sample Temperature, F	<u>60°F</u>	<u>60°F</u>
Sample Specific Gravity	<u>1.470 @ 60°</u>	<u>1.882 @ 62°</u>
Met Mil Spec. Requirements (Yes or No)	<u>YES</u>	<u>YES</u>

PREPARED BY E. Adams -61. 11/1/64	DATE 11/24/64	PERFORMED BY S. S. L. L. L. 11/24/64	DATE 11/24/64	WITNESSED FOR NAA B. J. Kelly 11/24/64	DATE 11/24/64	CERTIFIED FOR McDONNELL L. D. L. L. L. 11/24/64	DATE 11/24/64
				VERIFIED BY USAF DATE			

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 4388-5299

INTERNAL LETTER
North American Aviation, Inc.

DATE 21 December 1964

TO Inspection
Address D/554-944

FROM Gemini DAT-RAT Unit
Address D/896-388

SUBJECT Deviation to DAT Specification 208160-401

It is hereby authorized that the initial testing phase of the impulse signal width tests (paragraph 7.2.3.1 of DAT specification 208160-401) on SE7 25 lb TCA Unit #2 be repeated.

The initial data is believed to be invalid.


W. Richtenburg
Gemini DAT-RAT Unit

Approved: 
J. D. Mavrogenis
MAC Engineering

A DIVISION OF NORTH AMERICAN AVIATION, INC.

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110 OF 380

7.2.3.2.1 Component Identification

Component Name T.C.A. 25th

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058.232

Accumulated Acceptance Test Firing Time, seconds 17.03

Pre-Test	Post Test
.3578	.3579
2.242	2.260

7.2.3.2.2

Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	12-21-64	12-21-64
Sample Batch Number	12-224	12-226
Sample Temperature, F	60°F	77°F
Sample Specific Gravity	1.462	0.873
Met Mil Spec. Requirements (Yes or No)	Yes	Yes

PREPARED BY E. Adams et. 1/10/64	DATE 1/10/64	PERFORMED BY E. S. Kallgren 12/22/64	DATE 12/22/64	WITNESSED FOR NAA M J Kelly 12/22/64	DATE 12/22/64	CERTIFIED FOR McDONNELL James D. McDermott 2/9/65	DATE 2/9/65
				VERIFIED BY USAF		DATE	

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110 OF 380

7.2.3.2 Test Data - TCA # 2

7.2.3.2.1 Component Identification

ARR 930 DEC 29 64

REDA AFQC

Component Name 25# TCA

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058232

Accumulated Acceptance Test Firing Time, seconds 26.77

DEC 29

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pre-Test	Post Test
..3579	3579
2.260	2.260

7.2.3.2.2

Propellant Samples

ARR 930 DEC 29 64

REDA AFQC

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	12/28/64	12/28/64
Sample Batch Number	12-311	12-326
Sample Temperature, F	60°	77°
Sample Specific Gravity	1.461	0.873
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams 4/10/64	DATE 4/10/64	PERFORMED BY E.S. Sullivan 12/29/64	DATE 12/29/64	WITNESSED FOR NAA L.J. Kelly 12/29/64	DATE 12/29/64	CERTIFIED FOR McDONNELL R.L. Jones 2/6/65	DATE 2/6/65
VERIFIED BY USAF							

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110 OF 380

7.2.3.2 (ANR 930) Test Data - TCA # 2

7.2.3.2.1 (ANR 930) Component Identification

Component Name TCA 25#

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058232

Accumulated Acceptance Test Firing Time, seconds 38.87 (ANR 930)

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pre-Test	Post Test
3.579	3.579
2.260	2.260

7.2.3.2.2 (ANR 930) Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	1-4-65	1-4-65
Sample Batch Number	1-8	1-17
Sample Temperature, F	60°	77°
Sample Specific Gravity	1.461	0.872
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams 6-1. 1/10/64	DATE 1/10/64	PERFORMED BY E. S. Stibben 1/14/64	DATE 1/14/64	WITNESSED FOR NAA A. J. Kelly 1/14/64	DATE 1/14/64	CERTIFIED FOR McDONNELL L. O. P. Thompson 1/14/64	DATE 1/14/64
VERIFIED BY USAF							

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110 OF 380

7.2.3.2 Test Data - TCA # 2

7.2.3.2.1 Component Identification

Component Name TCA 25#

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058232

Accumulated Acceptance Test Firing Time, seconds 38.12

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pre-Test	Post Test
.3579	.3579
2.260	2.260

7.2.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	1-4-65	1-4-65
Sample Batch Number	1-8	1-17
Sample Temperature, F	60°	77°
Sample Specific Gravity	1.461	0.872
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams 4/10/64	DATE 1/7/65	PERFORMED BY E.S. Hubber	DATE 1/7/65	WITNESSED FOR NAA D.J. Kelly	DATE 1/7/65	CERTIFIED FOR McDONNELL James D. Harrington	DATE 2/19/65
VERIFIED BY USAF						DATE 1/14/65	

FORM 608-B-39 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110 OF 380

7.2.3.2 (930) 1/15/65 Test Data - TCA # 2

7.2.3.2.1 Component Identification

Component Name TCA 25#

McDonnell Part No. 52-52701-265

Rocketdyne Part No. 208160-61

Component Serial No. 4058232

Accumulated Acceptance Test Firing Time, seconds 41.77 (930) 1/15/65

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pro-Test	Post Test
.3579	.3578
2.260	2.260

7.2.3.2.2

Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	1-13-65	1-13-65
Sample Batch Number	1-136	1-138
Sample Temperature, F	60°	77°
Sample Specific Gravity	1.460	0.871
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams 4/10/64	DATE 1/15/65	PERFORMED BY E.S. Subban	DATE 1/15/65	WITNESSED FOR NAA A.J. Kelly	DATE 1/15/65	CERTIFIED FOR McDONNELL J. D. [Signature]	DATE 2/4/65
				VERIFIED BY USAF [Signature]			

FORM 608-B-39 NEW 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-⁴⁰¹ SHEET OF

IL 5388-6267

Deviation Request:

25 lb GEMINI DAT UNIT #2 (P/N 208160-61, S/N 4058232) shall be returned to SSFL to complete the DAT Test program, following the OFR (No.32656R) action. FAR action will be continued after the completion of the test program.

Recopied from original request dated 16 January, 1965.

James D. Mavrogenis
James L. Mavrogenis
MAC Engineering

2-2-65

J. A. Ganger
J.A. Ganger
Gemini Dat
Engineering

FORM 608-B-37 NEW 6-63

R-15019-2

349

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110 OF 380

7.2.3.2 (930) 1/16/65 Test Data - TCA # 2

7.2.3.2.1 Component Identification

Component Name

TCA 25#

McDonnell Part No.

52-52701-265

Rocketdyne Part No.

208160-61

Component Serial No.

4058232

Accumulated Acceptance Test Firing Time, seconds

42.02

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Pre-Test	Post Test
3578	3573
2.260	2.265

7.2.3.2.2 Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	1-13-65	1-13-65
Sample Batch Number	1-136	1-138
Sample Temperature, F	60°	77°
Sample Specific Gravity	1.460	0.871
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams Ed. 4/10/64	DATE 4/10/64	PERFORMED BY E. S. Hurlburt 1/16/65	DATE 1/16/65	WITNESSED FOR NAA A. J. Kelly 1/16/65	DATE 1/16/65	CERTIFIED FOR McDONNELL James D. Hargensen 2/4/65	DATE 2/4/65
				VERIFIED BY USAF			

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO. 208160-401 SHEET 110-7 OF 380

7.2.3.2 Test Data - TCA #2

7.2.3.2.1 Component Identification

1/29/65

Component Name

TCA

McDonnell Part No.

52-52701-265

Rocketdyne Part No.

208160-61

Component Serial No.

4058232

1/29/65

Accumulated Acceptance Test Firing Time, seconds

48.07

Throat Diameter, inches
(Average of four measurements)

1/29/65

Nozzle Exit Diameter, inches

Pre-Test	Post Test
3.578	3.532
2.261	2.458

7.2.3.2.2 Propellant Samples

1/29/65

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	1/27/65	1/27/65
Sample Batch Number	1-324	1-323
Sample Temperature, F	66°F	72°F
Sample Specific Gravity	1.465	.880
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams 4/10/64	DATE 1/29/65	PERFORMED BY E. S. Hribben 1/29/65	DATE 1/29/65	WITNESSED FOR NAA A. J. Kelly 1/29/65	DATE 1/29/65	CERTIFIED FOR McDONNELL James D. Hribben 1/29/65	DATE 1/29/65
				VERIFIED BY USAF 1/29/65			

FORM 608-B-39 NEW 6-63

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058232

Dwg. No. 208/60-61

Model SE 7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY		
			Mech. & Date	Lead-man & Date	Insp. & Date
1	12/22/64 ANR 930	CTLM SSFL PART NO. INFO: H/F TEST. IMPULSE SIGNAL WIDTH TEST WITNESSING WAIVED BY MAC REP J. MAUROGENIS PER TEL-CON 12/22/64			
		ACTION TAKEN INFORMATION ONLY NO ACTION REQUIRED	12/22/64 ANR 930	12/22/64 ANR 930	
2	12/22/64 ANR 718	PART NO. General NO New Test Procedure sheets received with the book for retesting of the T.C.R. The old sheets are double stamped & dated for the retest			
		ACTION TAKEN Information Only	12/22/64 ANR 718	12/22/64 ANR 718	
3	12/29/64 ANR 930	PART NO. GENERAL: HOT FIRE TEST IMPULSE SIGNAL WIDTH PARA. 7.2.3.2.3.2 WITNESSING WAIVED BY MAC REP J. MAUROGENIS PER TEL-CON 12/29/64			
		ACTION TAKEN INFORMATIONAL ONLY	12/29/64 ANR 930	12/29/64 ANR 930	
4	12/29/64 ANR 930	PART NO. ^{TWO} GENERAL: AN EXTRA TEST WAS RUN BEFORE STARTING PULSE SERIES FOR IMPULSE SIGNAL WIDTH.			
		ACTION TAKEN EXTRA TEST ACCEPTABLE PER IL 4388-5309	1/4/65 ANR 930	1/4/65 ANR 930	
5	1/6/65 ANR 930	PART NO. 208/60-61 & N 4058232 DURING H/F TEST #005 TO 007 THERE WAS NO PROPELLANT FLOW.			
		ACTION TAKEN INSTRUMENT TATTOO INDICATES THAT PROPELLANT IS FROZEN. REVISE PROP. TEMPS FROM 15 TO 20 °F. REVISE INJ. TEMP FROM 15 TO 25 °F. AND RESTART COLD MODE PULSE REPEATABILITY	1/4/65 ANR 930	1/6/65 ANR 930	

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058232

Dwg. No. 208160-61

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY		
			Mech. & Date	Lead-man & Date	Insp. & Date
6	1/6/65 (ANR 930)	PART NO. <u>208160-61 S/N 4058232 DURING H/F TEST 008 TO 010. NTO</u>			
		<u>FLOW WAS INTERMITTENT</u>			
ACTION TAKEN		ANALYSIS OF TEST DATA INDICATES THAT PROPELLANT FROZE AS A RESULT OF UNEQUAL HARDWARE COOLING. TESTS CONDUCTED ON A MORE SOPHISTICATED COOLING TECHNIQUE INDICATES SATISFACTORY TEMPERATURE CONTROL. OK TO TEST. <i>J.A. Singer 1/9/65</i>	(ANR 930) 1/9/65	(ANR 930) 1/9/65	
7	1/9/65 (ANR 930)	PART NO. <u>208160-61 S/N 4058232 DECONTAMINATION COMPLETED UP TO AND INCLUDING PARA. 6.8.35</u>			
ACTION TAKEN		<u>DECONTAMINATION COMPLETE PARA. 6.8.36 TO 6.8.41</u>	(ANR 930) 1-11-65	(ANR 930) 1-11-65	
8	1/16/65 (ANR 930)	PART NO. <u>208160-61 S/N 4058232 START OF H/F TEST 020. NO NTO</u>			
		<u>FLOW WAS OBSERVED ON CHART. PROPELLANTS AND INJECTOR FACE WERE AT 21°F & 24°F</u> <u>WERE AT 15°F.</u>			
ACTION TAKEN		<u>Made facility changes to control all temperatures at 20°. OK to resume testing</u> <i>N.A. Cole 896-388</i>	(ANR 930) 1-16-65	(ANR 930)	
9	1/16/65 (ANR 930)	PART NO. <u>208160-61 S/N 4058232 START OF H/F TEST 021 NO NTO</u>			
		<u>FLOW WAS OBSERVED AFTER 3RD PULSE.</u>			
ACTION TAKEN		<u>TRANSFERRED TO SHORTAGE</u>	(ANR 930) 1-18-65	(ANR 930)	

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST TEST NO 208160-401 SHEET 401 OF 401

TEST PHASE: Impulse vs Signal Survey

Volts = 26 Temp. = 70°	Pulse Number	1	2	6	8	12	Avg
Signal Width, msec		10.8	10.8	10.5	10.8	10.9	10.8
Ignition Time, msec		12.6	12.7	8.0	7.0	7.5	9.6
Rise Time, msec		4.2	5.0	3.9	5.0	4.4	4.5
Effective Firing Time, msec		4.4	3.2	4.5	4.3	4.6	4.2
Cut-Off Time, msec		9.2	9.0	8.1	8.0	7.4	8.3
Decay Time, msec		2.9	3.8	2.1	2.4	1.7	2.6
Shutdown Impulse, lb-sec		1412	1309	1349	1296	1316	1336
Pulse Total Impulse, lb-sec		1556	1497	1479	1520	1531	1517
Mean Specific Impulse, sec		144.5	147.2	149.4	136.7	146.4	144.8

Volts = 26 Temp. = 70°	Pulse Number	2	5	7	9	12	Avg
Signal Width, msec		15.2	15.1	14.8	14.8	14.8	14.9
Ignition Time, msec		4.2	7.7	7.7	7.7	7.3	6.9
Rise Time, msec		4.2	5.8	5.0	6.0	4.7	5.1
Effective Firing Time, msec		7.0	6.8	8.1	6.0	7.6	7.1
Cut-Off Time, msec		10.9	8.4	9.8	9.6	9.8	9.7
Decay Time, msec		5.5	3.0	3.8	4.5	5.0	4.4
Shutdown Impulse, lb-sec (.260 max)*		1628	1376	1643	1530	1411	1518
Pulse Total Impulse, lb-sec		2382	2245	2528	2431	2438	2405
Mean Specific Impulse, sec (235 min)		183.2	165.3	185.1	180.2	178.3	178.4

Volts = 26 Temp. = 70°	Pulse Number	2	3	4	7	8	Avg
Signal Width, msec		19.7	20.1	20.1	19.8	19.9	19.9
Ignition Time, msec		8.7	7.3	6.8	6.8	6.7	7.3
Rise Time, msec		5.6	6.1	6.2	6.3	5.9	6.1
Effective Firing Time, msec		11.0	12.3	12.6	12.6	12.6	12.2
Cut-Off Time, msec		11.6	11.3	10.9	11.2	10.9	11.2
Decay Time, msec		5.9	5.6	4.9	5.2	5.5	5.4
Shutdown Impulse, lb-sec		1747	1606	1698	1624	1479	1631
Pulse Total Impulse, lb-sec		3649	3687	3657	3789	3766	3710
Mean Specific Impulse, sec		204.7	206.0	196.6	205.4	211.9	203.9

* Ref: EGN NA-SE6-289R1

Prepared by: W. J. Johnson Checked by: [Signature] Approved for: [Signature] by: [Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 251 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST TEST NO 208160-401 SHEET 1 OF 1

TEST PHASE: Impulse vs Signal Survey (cont'd)

Volts = 26 Temp. = 70°	Pulse Number	2	5	6	8	9	Avg
Signal Width, msec		30.1	30.1	30.0	29.9	29.9	30.0
Ignition Time, msec		6.8	7.8	7.7	8.2	7.8	7.7
Rise Time, msec		6.7	5.3	5.9	4.4	5.2	5.5
Effective Firing Time, msec		21.3	21.9	21.7	23.2	22.5	22.1
Cut-Off Time, msec		11.4	10.7	10.4	10.6	9.9	10.6
Decay Time, msec		6.7	5.7	5.0	4.7	4.2	5.3
Shutdown Impulse, lb-sec		1595	1536	1715	1710	1691	1649
Pulse Total Impulse, lb-sec		5927	5956	5956	5970	6089	5980
Mean Specific Impulse, sec		222.3	221.1	220.0	224.8	229.8	223.6

Volts = 26 Temp. = 70°	Pulse Number	1	3	5	7	10	Avg
Signal Width, msec		49.8	50.1	49.9	49.8	49.7	49.9
Ignition Time, msec		7.9	6.8	7.7	7.8	7.7	7.6
Rise Time, msec		8.1	6.0	6.8	7.0	7.3	7.0
Effective Firing Time, msec		39.0	41.5	39.8	40.0	41.2	40.1
Cut-Off Time, msec		13.2	10.2	10.4	9.4	7.6	10.2
Decay Time, msec		8.0	6.0	6.0	5.5	2.0	5.5
Shutdown Impulse, lb-sec		1974	1656	1606	1470	1772	1696
Pulse Total Impulse, lb-sec		1076	1075	1044	1028	1059	1056
Mean Specific Impulse, sec		248.9	245.4	244.0	244.2	246.3	245.8

Volts = 26 Temp. = 70°	Pulse Number	1	2	5	6	8	Avg
Signal Width, msec		99.8	100.3	99.8	99.8	99.8	99.9
Ignition Time, msec		7.7	7.0	8.5	8.0	7.0	7.6
Rise Time, msec		5.2	8.5	5.0	5.5	7.0	6.2
Effective Firing Time, msec		91.5	88.5	89.0	91.5	91.5	90.2
Cut-Off Time, msec		10.7	10.2	11.6	9.5	10.3	10.5
Decay Time, msec		6.0	6.5	7.2	4.2	6.0	6.0
Shutdown Impulse, lb-sec		1742	1510	1635	1779	1589	1651
Pulse Total Impulse, lb-sec		2241	2208	2223	2231	2216	2224
Mean Specific Impulse, sec		264.4	263.4	265.7	262.8	263.5	264.0

Prepared by: W. J. Schuman

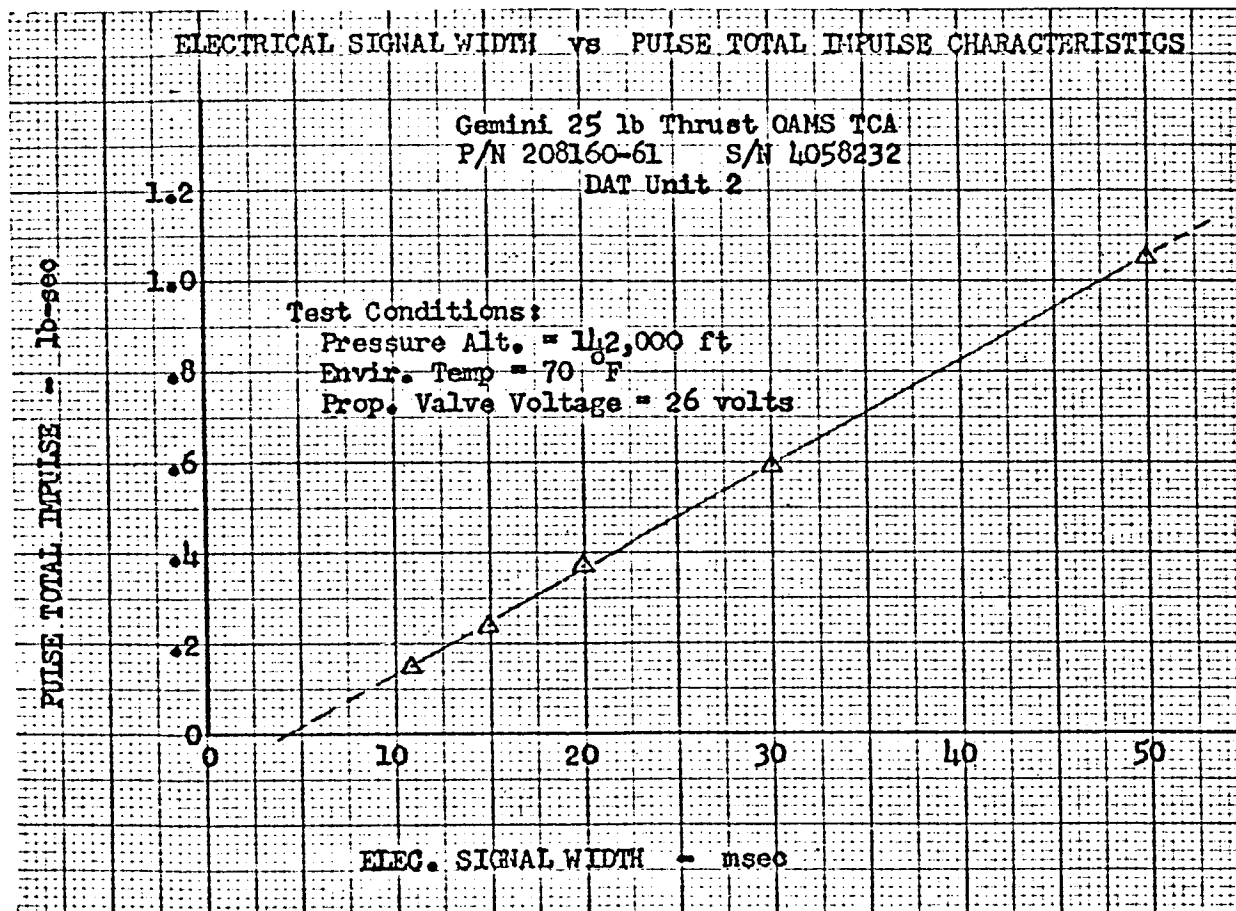
Checked by: [Signature]

Approved by: [Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME 25 lb THRUST OAMS TCA DAT UNIT 2 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST NO 208160-⁴⁰¹ SHEET 1 OF 1



PREPARED BY: <i>B. J. Johnson</i>	DATE <i>9/24/65</i>	APPROVED FOR NAA: <i>[Signature]</i>	DATE	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE				

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

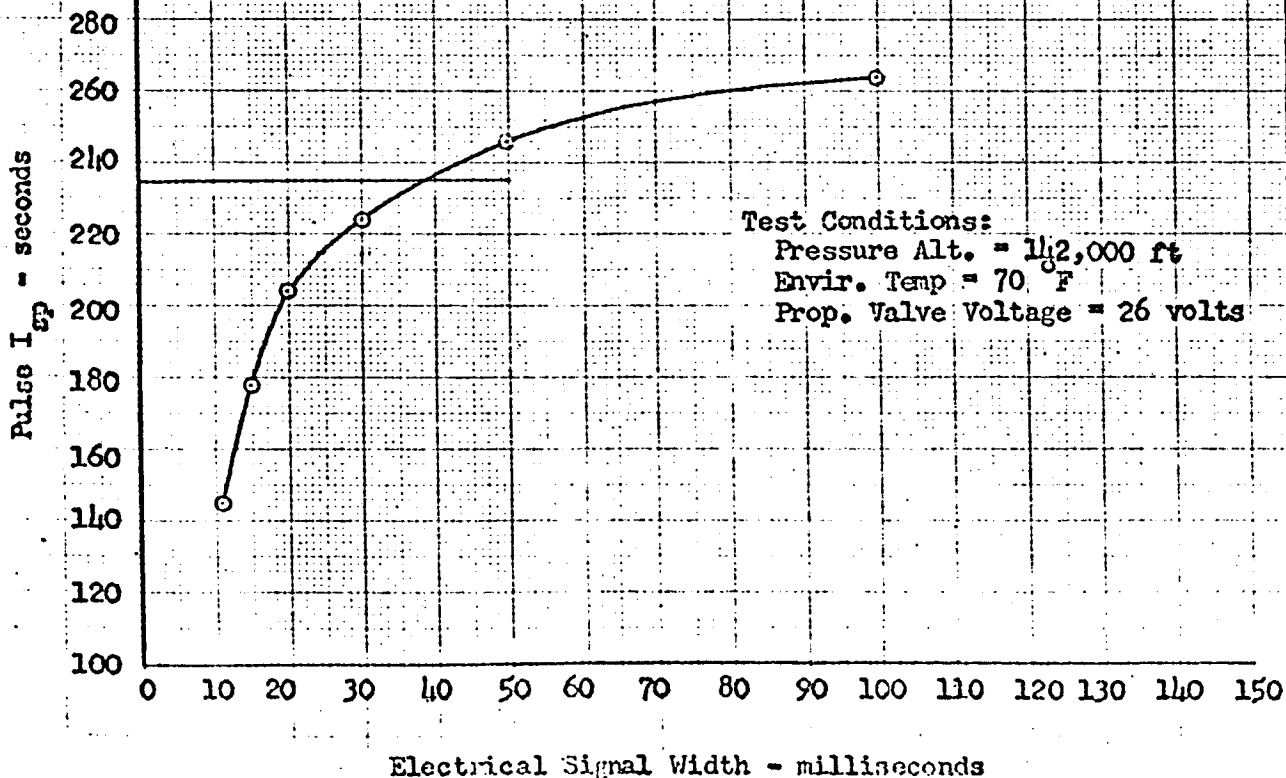
**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
TEST NO. IMPULSE SIGNAL WIDTH TEST SHEET OF

~~CONFIDENTIAL~~

ELECTRICAL SIGNAL WIDTH vs PULSE SPECIFIC IMPULSE CHARACTERISTICS

Gemini 25 lb Thrust OAMS TCA
P/N 208160-61 S/N 4058232
DAT Unit 2



FORM 608-B-40 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 2511 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST TEST NO 208160-401 SHEET 1 OF 1

TEST PHASE: Signal Width Repeatability at Ambient Temperature

Volts = 22 Temp. = 70°	Pulse Number	1	3	5	7	8	Avg
Signal Width, msec		14.1	14.3	14.3	14.2	14.1	14.2
Ignition Time, msec		8.5	8.5	8.0	8.5	8.5	8.4
Rise Time, msec		8.6	6.9	6.7	6.8	6.5	7.1
Effective Firing Time, msec		6.0	7.5	7.6	7.7	8.1	7.4
Cut-Off Time, msec		11.1	7.7	7.8	8.0	8.1	8.5
Decay Time, msec		4.6	4.6	4.2	4.1	3.7	4.2
Shutdown Impulse, lb-sec		159.2	163.4	145.0	156.7	146.9	154.2
Pulse Total Impulse, lb-sec		215.7	224.9	217.3	225.3	214.1	219.5
Mean Specific Impulse, sec		159.3	158.2	143.1	171.5	159.8	162.4

Volts = 26 Temp. = 70°	Pulse Number	2	3	8	11	12	Avg
Signal Width, msec		15.1	14.9	14.8	15.2	15.2	15.0
Ignition Time, msec		8.6	7.7	8.3	8.6	8.3	8.3
Rise Time, msec		4.6	6.9	5.9	4.4	4.4	5.2
Effective Firing Time, msec		6.6	5.7	6.0	6.8	7.3	6.5
Cut-Off Time, msec		9.1	9.3	9.9	9.8	6.7	9.0
Decay Time, msec		2.5	1.8	2.1	2.5	2.7	2.3
Shutdown Impulse, lb-sec (.260 max) *		140.5	142.7	150.3	141.7	130.6	141.2
Pulse Total Impulse, lb-sec		224.8	225.0	247.1	268.3	249.3	242.9
Mean Specific Impulse, sec (235 min)		168.7	163.5	170.2	174.5	174.4	170.3

Volts = 30 Temp. = 70°	Pulse Number	4	5	7	9	11	Avg
Signal Width, msec		16.9	16.9	17.1	16.9	17.1	17.0
Ignition Time, msec		8.2	8.2	8.7	7.6	6.3	7.8
Rise Time, msec		5.8	5.8	4.5	6.9	6.2	5.8
Effective Firing Time, msec		7.2	7.2	7.4	6.4	8.0	7.2
Cut-Off Time, msec		10.0	9.6	10.0	9.6	10.3	9.9
Decay Time, msec		3.4	5.2	4.3	3.0	4.5	4.1
Shutdown Impulse, lb-sec		159.7	145.0	154.9	167.4	160.0	157.4
Pulse Total Impulse, lb-sec		274.0	256.9	272.1	276.1	272.9	270.4
Mean Specific Impulse, sec		171.4	171.7	172.8	169.3	176.0	172.2

* Ref: ECN NA-SF6-289R1

Prepared by: [Signature] Checked by: [Signature] Approved by: [Signature]

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 251 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST TEST NO 208160-101 SHEET 101 OF 101

TEST PHASE: Signal Width Repeatability (Hot Mode)

Volts = 22 Temp. = 160°	Pulse Number	1	5	8	10	12	Avg
Signal Width, msec		12.9	12.8	12.8	12.9	13.2	12.9
Ignition Time, msec		8.7	8.7	7.8	8.8	9.7	8.7
Rise Time, msec		5.9	6.6	6.4	5.2	4.9	5.8
Effective Firing Time, msec		3.6	3.1	3.8	3.5	3.4	3.5
Cut-Off Time, msec		14.7	15.2	15.1	15.1	15.0	15.0
Decay Time, msec		9.4	9.6	9.9	10.5	10.2	9.9
Shutdown Impulse, lb-sec		1669	1686	1647	1569	1607	1636
Pulse Total Impulse, lb-sec		2093	2020	2114	2029	2007	2053
Mean Specific Impulse, sec		177.5	171.3	176.4	170.3	173.9	173.9

Volts = 26 Temp. = 160°	Pulse Number	2	5	7	9	10	Avg
Signal Width, msec		14.7	14.9	14.9	14.8	14.8	14.8
Ignition Time, msec		8.3	8.7	8.3	8.3	8.7	8.5
Rise Time, msec		6.0	5.0	6.0	5.2	5.3	5.5
Effective Firing Time, msec		5.5	5.7	5.0	6.0	5.5	5.5
Cut-Off Time, msec		14.7	15.1	15.0	14.5	13.9	14.6
Decay Time, msec		9.6	10.6	10.6	9.8	9.2	10.0
Shutdown Impulse, lb-sec		1686	1648	1603	1714	1697	1670
Pulse Total Impulse, lb-sec		2547	2570	2540	2588	2556	2560
Mean Specific Impulse, sec		189.2	179.9	185.4	186.6	190.2	186.3

Volts = 30 Temp. = 160°	Pulse Number	5	7	9	11	12	Avg
Signal Width, msec		16.0	16.1	16.1	16.1	16.1	16.1
Ignition Time, msec		8.6	9.1	7.6	8.6	8.9	8.8
Rise Time, msec		5.8	5.9	5.9	6.9	7.1	6.3
Effective Firing Time, msec		5.5	4.5	6.0	5.0	5.1	5.2
Cut-Off Time, msec		14.6	15.0	14.5	14.7	15.1	14.8
Decay Time, msec		10.8	11.4	11.0	10.2	10.1	10.7
Shutdown Impulse, lb-sec		1484	1639	1551	1749	1797	1644
Pulse Total Impulse, lb-sec		2549	2586	2755	2774	2667	2666
Mean Specific Impulse, sec		185.8	177.4	190.1	194.5	173.2	184.0

Prepared by: 121 224-1111-1111 Checked by: [Signature] Approved by: [Signature]
FORM 608-B-37 NEW 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 257 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IMPULSE SIGNAL WIDTH TEST TEST NO 208160-401 SHEET 1 OF 1

TEST PHASE: Signal Width Repeatability (Cold Mode)

Volts = 22 Temp. = 20°	Pulse Number	1	2	7	9	10	Avg
Signal Width, msec		13.0	12.8	12.9	13.0	12.9	12.9
Ignition Time, msec		9.3	9.2	8.7	9.3	8.4	8.8
Rise Time, msec		6.7	5.0	4.9	6.5	5.3	5.7
Effective Firing Time, msec		3.4	5.0	4.8	3.4	4.3	4.2
Cut-Off Time, msec		11.2	8.4	9.3	9.2	9.1	9.4
Decay Time, msec		4.9	2.1	3.8	4.0	4.0	3.8
Shutdown Impulse, lb-sec		1551	1656	1555	1486	1507	1535
Pulse Total Impulse, lb-sec		1830	2027	1900	1871	2011	1928
Mean Specific Impulse, sec		137.1	157.0	152.7	145.5	164.2	151.3

Volts = 26 Temp. = 20°	Pulse Number	2	4	7	9	11	Avg
Signal Width, msec		13.3	13.3	13.3	13.3	13.3	13.3
Ignition Time, msec		8.5	6.8	7.3	7.7	7.7	7.6
Rise Time, msec		4.8	4.7	7.5	6.0	5.6	5.7
Effective Firing Time, msec		7.2	7.3	6.0	6.0	6.1	6.5
Cut-Off Time, msec		9.8	10.0	9.5	9.6	10.6	9.9
Decay Time, msec		2.6	4.5	2.0	3.2	4.5	3.4
Shutdown Impulse, lb-sec		1880	1645	1856	1759	1743	1727
Pulse Total Impulse, lb-sec		2423	2595	2534	2432	2340	2465
Mean Specific Impulse, sec							

Volts = 30 Temp. = 20°	Pulse Number	3	4	6	8	11	Avg
Signal Width, msec		16.9	16.9	16.8	17.0	17.0	16.9
Ignition Time, msec		9.1	8.6	7.5	6.6	8.5	8.1
Rise Time, msec		5.7	6.8	6.5	8.1	6.6	6.7
Effective Firing Time, msec		6.5	6.5	8.1	7.4	6.9	7.1
Cut-Off Time, msec		9.4	8.7	8.1	7.6	8.0	8.4
Decay Time, msec		5.0	3.6	2.8	2.4	2.9	3.3
Shutdown Impulse, lb-sec		1379	1423	1565	1529	1486	1486
Pulse Total Impulse, lb-sec		2469	2555	2845	2970	2736	2715
Mean Specific Impulse, sec		185.7	166.6	181.4	173.8	179.1	177.3

Prepared by: W. J. Johnson Checked by: W. J. Johnson Approved for data by: W. J. Johnson

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME TERUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO 208260-401 SHEET 313 OF 380

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.3.1.3.2.2

7.2.4 DAT Duty Cycle to 160 Seconds - TCA #2

7.2.4.1 Test Procedure

7.2.4.1.2 Perform DAT Duty Cycle Firing Test per paragraph 6.7 and Table II. The TCA shall be fired for an accumulated duration of 160 seconds without catastrophic failure.

7.2.4.1.3 Perform decontamination per paragraph 6.8.

7.2.4.1.4 Reduce data per SEM 4388-4040.

7.2.4.1.4.1 The results of significant data shall include but not be limited to the following:

7.2.4.1.4.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations.

7.2.4.1.4.1.2 Graphical presentation of total impulse versus signal width.

7.2.4.1.4.1.3 Graphical presentation of mean specific impulse versus signal width.

7.2.4.1.5 Perform weight determination per paragraph 6.6.

PREPARED BY: R.Cole	DATE 1-27-65	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: J.A. Sanger	DATE 1/28/65	[Signature]		[Signature]	

FORM 608-B-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-401 SHEET 31 OF 380

7.2.4.2 Test Data - TCA #2

7.2.4.2.1 Component Identification

Component Name

TCA

McDonnell Part No.

52-52701-265

Rocketdyne Part No.

208160-61

Component Serial No.

9058232

Accumulated Acceptance Test Firing Time, seconds 191.75

Pre-Test	Post Test
Throat Diameter, inches (Average of four measurements)	3578 3532
Nozzle Exit Diameter, inches (Average of four measurements)	2.261 2.458

7.2.4.2.2

Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	1/27/65	1/27/65
Sample Batch Number	1-324	1-323
Sample Temperature, F	66° F	72° F
Sample Specific Gravity	1.465	1.880
Met Mil Spec. Requirements (Yes or No)	YES	YES

PREPARED BY E. Adams	DATE 4/1/64	PERFORMED BY E.A. Cole	DATE 1-28-65	WITNESSED FOR NAA J. D. Williams	DATE 1-28-65	CERTIFIED FOR McDONNELL James D. Williams	DATE 3/11/65
				VERIFIED BY USAF		DATE 3/11/65	

FORM 603-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-401 SHEET 315 OF 380

7.2.4.2.4 DAT Duty Cycle Data (reference paragraph 7.2.4.1)

Test Cell Location C-7 III

Test Cell Number 39 J

Test Number 037

Test Date 1/29/65

NOTE: All data corrected to Standard Vacuum conditions.

PREPARED BY R. Cole J. Ganger 9/29/64	DATE	PERFORMED BY <i>R. A. Cole</i>	DATE	WITNESSED FOR NAA <i>William W. ...</i> 129-65	DATE	CERTIFIED FOR McDONNELL <i>James D. ...</i> 2/11/65 VERIFIED BY USAF <i>...</i> 12/16/65	DATE
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FORM 608-B-39 NEW 6-63

R-15019-2

1363

ROCKETDYNE

INSPECTION DISCREPANCY AND CORRECTION RECORD

MAKE ENTRY CLEAR AND CONCISE, USE INK

Serial No. 4058232

Dwg. No. 208160-61

Model SE-7

DCP No.	Ent'd By & Date	DESCRIPTION OF DISCREPANCY AND ACTION TAKEN	CLEARED BY		
			Mech. & Date	Lead-man & Date	Insp. & Date
		PART NO.			
		<i>Inspection Complete D/056 CTL III</i>			
		<i>1/18/65</i> ANR 930			
	ACTION TAKEN				
# 10	<i>1/29/65</i> ANR 930	PART NO. <u>208160-61 S/N 4058232</u> SKIN TEMP. EXCEEDED 550°F BEFORE 116 SEC. ACCUM FIRING TIME. REF. TABLE II NOTE (2)			
	ACTION TAKEN	<i>Transferred to Storage</i>			
# 11	<i>1/29/65</i> ANR 930	PART NO. <u>208160-61 S/N 4058232</u> SKIN TEMP. EXCEEDED 700°F BEFORE 134 SEC. ACCUM FIRING TIME. REF. TABLE II NOTE (3)			
	ACTION TAKEN	<i>Transferred to Storage</i>			
#	<i>1/29/65</i> ANR 930	PART NO. <u>208160-61, S/N 4058232</u> - Post test insp. reveals ablative material eroded, delaminating & cracking.			
	ACTION TAKEN	<i>Transferred to Storage</i>			
# 13	<i>1/29/65</i> ANR 930	PART NO. <u>208160-61, S/N 4058232</u> - Post test insp. reveals evidence of excessive heat, as indicated by discoloration of a portion of exterior - I/c.			
	ACTION TAKEN	<i>Transferred to Storage</i>			

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 254 PART NO. { MAC 52-52701-265
NAA 208160
101
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-SHEET OF 101

Sequence Number 1

Pulse Number	2	16	34
Signal Width, msec	27.7	27.4	30.0
Start Time, msec (25 max.)	13.5	13.3	14.0
Environmental Pressure, psia	.013	.013	.013
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	.00135	.00133	.00148
Total Fuel Flow, lbs	.00105	.00105	.00114
Mean Mixture Ratio, o/f	1.287	1.270	1.300
Pulse Total Impulse, lb-sec	.5470	.5389	.5977
Mean Specific Impulse, sec	227.8	226.4	227.8
Shutdown Impulse, lb-sec (.260 max) *	.1857	.1613	.1569
Cut-Off Time, msec	12.4	11.3	10.7
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.645	.645	.645
Fuel Valve Current, amps	.639	.639	.639
Electrical Power, watts	33.4	33.4	33.4

* Ref: ECN NA-SE6-289R1.

Prepared by: H. Robinson

Checked by: [Signature]

Approved for JAS by: [Signature]

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST MANIPULATOR ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 203160-101 SHEET 101 OF 101

Sequence Number <u>2</u>	Site Data	Standard Vacuum
Pulse Number <u>1</u>		
Firing Duration, sec	<u>4.2</u>	
Accumulated Firing Time, sec	<u>21.0</u>	
Data Slice Number	<u>1</u>	
Time of Data Slice, sec	<u>4.0</u>	
Environmental Pressure, psia	<u>.012</u>	0
Environmental Temperature, °F	<u>41</u> (VAC. chamber)	
Oxidizer Temperature, °F	<u>58</u>	70
Fuel Temperature, °F	<u>59</u>	70
Oxidizer Inlet Pressure, psia	<u>294.4</u>	292
Fuel Inlet Pressure, psia	<u>294.4</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0470</u>	<u>.0464</u>
Fuel Flowrate, lbs/sec	<u>.0355</u>	<u>.0353</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.32</u>	<u>1.31</u>
Thrust, lbs (23.0±5%)	<u>24.3</u>	<u>24.1</u>
Specific Impulse (272 min.)	<u>294</u>	<u>295</u>
Start Time, msec (25 max)	<u>16</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.1796</u>	
Oxidizer Valve Voltage, volts	<u>25.5</u>	
Fuel Valve Voltage, volts	<u>25.3</u>	
Oxidizer Valve Current, amps	<u>.650</u>	
Fuel Valve Current, amps	<u>.629</u>	
Electrical Power, watts	<u>32.5</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 203160-101 SHEET 101 OF 101

Sequence Number <u>3</u>	Site Data	Standard Vacuum
Pulse Number <u>1</u>		
Firing Duration, sec	<u>.687</u>	
Accumulated Firing Time, sec	<u>21.8</u>	
Data Slice Number	<u>2</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.016</u>	0
Environmental Temperature, °F	<u>41</u> (VHC chamber)	
Oxidizer Temperature, °F	<u>58</u>	70
Fuel Temperature, °F	<u>59</u>	70
Oxidizer Inlet Pressure, psia	<u>298.6</u>	292
Fuel Inlet Pressure, psia	<u>294.5</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0471</u>	<u>.0461</u>
Fuel Flowrate, lbs/sec	<u>.0353</u>	<u>.0352</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.34</u>	<u>1.31</u>
Thrust, lbs (23.0±5%)	<u>24.3</u>	<u>24.0</u>
Specific Impulse	<u>295</u>	<u>296</u>
Start Time, msec (25 max)	<u>14</u>	
Shutdown Impulse, lb-sec (.260 max)*	<u>.1718</u>	
Oxidizer Valve Voltage, volts	<u>25.8</u>	
Fuel Valve Voltage, volts	<u>25.3</u>	
Oxidizer Valve Current, amps	<u>.636</u>	
Fuel Valve Current, amps	<u>.621</u>	
Electrical Power, watts	<u>32.1</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

12/5/2010

Checked by:

[Signature]

Approved for NAA:

[Signature]

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160 SHEET 1 OF 1

Sequence Number 4

Pulse Number	2	8	26
Signal Width, msec	17.1	17.6	17.8
Start Time, msec (25 max.)	15.1	16.1	16.3
Environmental Pressure, psia	.013	.013	.013
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	.00092	.00093	.00093
Total Fuel Flow, lbs	.00074	.00077	.00077
Mean Mixture Ratio, o/f	1.246	1.206	1.203
Pulse Total Impulse, lb-sec	.2764	.2712	.2899
Mean Specific Impulse, sec	166.3	160.0	170.6
Shutdown Impulse, lb-sec (.260 max)*	.1749	.1583	.1623
Cut-Off Time, msec	13.3	12.4	12.9
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.645	.645	.645
Fuel Valve Current, amps	.639	.639	.639
Electrical Power, watts	33.4	33.4	33.4

* Ref: EGN NA-SE6-289R1

Prepared by: <i>R. Robinson</i>	Checked by: <i>A. J. Probert</i>	Approved for NAA by: <i>R. Robinson</i>
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FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 251 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>5</u>	Site Data	Standard Vacuum
Pulse Number <u>3</u>		
Firing Duration, sec	<u>.694</u>	
Accumulated Firing Time, sec	<u>26.4</u>	
Data Slice Number	<u>3</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.013</u>	0
Environmental Temperature, °F	<u>44</u> (VHE, chamber)	
Oxidizer Temperature, °F	<u>61</u>	70
Fuel Temperature, °F	<u>61</u>	70
Oxidizer Inlet Pressure, psia	<u>296.5</u>	292
Fuel Inlet Pressure, psia	<u>294.5</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0479</u>	<u>.0471</u>
Fuel Flowrate, lbs/sec	<u>.0354</u>	<u>.0353</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.35</u>	<u>1.34</u>
Thrust, lbs (23.0±5%)	<u>24.0</u>	<u>23.8</u>
Specific Impulse	<u>288</u>	<u>289</u>
Start Time, msec (25 max)	<u>13</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.1687</u>	
Oxidizer Valve Voltage, volts	<u>25.8</u>	
Fuel Valve Voltage, volts	<u>25.4</u>	
Oxidizer Valve Current, amps	<u>.639</u>	
Fuel Valve Current, amps	<u>.621</u>	
Electrical Power, watts	<u>32.3</u>	

*Ref: ECN NA-SE6-289R1

Prepared by:

W. Robinson

Checked by:

W. Robinson

Approved: *W. Robinson*

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160 SHEET 1 OF 1

Sequence Number 6

Pulse Number	2	16	26
Signal Width, msec	22.9	23.2	21.2
Start Time, msec (25 max.)	13.7	15.9	14.7
Environmental Pressure, psia	.013	.013	.013
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	.00118	.00121	.00107
Total Fuel Flow, lbs	.00096	.00101	.00088
Mean Mixture Ratio, o/f	1.232	1.207	1.216
Pulse Total Impulse, lb-sec	.4415	.4254	.3733
Mean Specific Impulse, sec	206.8	191.7	191.2
Shutdown Impulse, lb-sec (.260 max) *	.1760	.1707	.1724
Cut-Off Time, msec	12.3	11.3	11.3
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.645	.645	.645
Fuel Valve Current, amps	.639	.639	.639
Electrical Power, watts	33.4	33.4	33.4

* Ref: EGN NA-SE6-289R1

Prepared by: W. Robinson Checked by: [Signature] Approved for NAA by: [Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-SHEET OF 401

Sequence Number 7

Pulse Number	<u>16</u>	<u>101</u>	
Signal Width, msec	<u>34.9</u>	<u>37.2</u>	
Start Time, msec (25 max.)	<u>14.6</u>	<u>12.7</u>	
Environmental Pressure, psia	<u>.013</u>	<u>.013</u>	
Environmental Temperature, °F	<u>70</u>	<u>70</u>	
Oxidizer Inlet Temperature, °F	<u>70</u>	<u>70</u>	
Fuel Inlet Temperature, °F	<u>70</u>	<u>70</u>	
Oxidizer Inlet Pressure, psia	<u>292</u>	<u>292</u>	
Fuel Inlet Pressure, psia	<u>292</u>	<u>292</u>	
Total Oxidizer Flow, lbs	<u>.00173</u>	<u>.00181</u>	
Total Fuel Flow, lbs	<u>.00139</u>	<u>.00142</u>	
Mean Mixture Ratio, o/f	<u>1.242</u>	<u>1.272</u>	
Pulse Total Impulse, lb-sec	<u>.7103</u>	<u>.7362</u>	
Mean Specific Impulse, sec	<u>227.6</u>	<u>227.9</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.1654</u>	<u>.1464</u>	
Cut-Off Time, msec	<u>11.3</u>	<u>11.3</u>	
Oxidizer Valve Voltage, volts	<u>26</u>	<u>26</u>	
Fuel Valve Voltage, volts	<u>26</u>	<u>26</u>	
Oxidizer Valve Current, amps	<u>.645</u>	<u>.645</u>	
Fuel Valve Current, amps	<u>.639</u>	<u>.639</u>	
Electrical Power, watts	<u>33.4</u>	<u>33.4</u>	

*Ref: ECN NA-SE6-289R1

Prepared by:

W. Robinson

Checked by:

[Signature]

Approved for Test by:

[Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>8</u>	Site Data	Standard Vacuum
Pulse Number <u>3</u>		
Firing Duration, sec	<u>1692</u>	
Accumulated Firing Time, sec	<u>35.7</u>	
Data Slice Number	<u>4</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.013</u>	0
Environmental Temperature, °F	<u>49 (vac. chamber)</u>	
Oxidizer Temperature, °F	<u>63</u>	70
Fuel Temperature, °F	<u>63</u>	70
Oxidizer Inlet Pressure, psia	<u>294.4</u>	292
Fuel Inlet Pressure, psia	<u>294.5</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0476</u>	<u>.0471</u>
Fuel Flowrate, lbs/sec	<u>.0359</u>	<u>.0352</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.33</u>	<u>1.32</u>
Thrust, lbs (23.0±5%)	<u>24.3</u>	<u>24.2</u>
Specific Impulse	<u>291</u>	<u>292</u>
Start Time, msec (25 max)	<u>16</u>	
Shutdown Impulse, lb-sec (.260 max)*	<u>.1811</u>	
Oxidizer Valve Voltage, volts	<u>25.8</u>	
Fuel Valve Voltage, volts	<u>25.3</u>	
Oxidizer Valve Current, amps	<u>.639</u>	
Fuel Valve Current, amps	<u>.615</u>	
Electrical Power, watts	<u>32.0</u>	

*Ref: EGN NA-SE6-289R1

Prepared by:

W. Robinson

Checked by:

W. J. [Signature]

Approved for H/W by:

[Signature]

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-SHEET OF

Sequence Number 9

Pulse Number	2	4	
Signal Width, msec	32.7	32.4	
Start Time, msec (25 max.)	11.5	12.2	
Environmental Pressure, psia	.013	.013	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	
Fuel Inlet Pressure, psia	292	292	
Total Oxidizer Flow, lbs	.00163	.00158	
Total Fuel Flow, lbs	.00131	.00126	
Mean Mixture Ratio, o/f	1.244	1.252	
Pulse Total Impulse, lb-sec	.7191	.6928	
Mean Specific Impulse, sec	244.3	243.8	
Shutdown Impulse, lb-sec (.260 max)*	.2050	.2072	
Cut-Off Time, msec	12.7	12.2	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.645	.645	
Fuel Valve Current, amps	.639	.639	
Electrical Power, watts	33.4	33.4	

* Ref: ECN NA-SE6-289R1

Prepared by: <i>H. Robinson</i>	Checked by: <i>[Signature]</i>	Approved for NAA by: <i>[Signature]</i>
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FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number 10

Pulse Number	4	9	541
Signal Width, msec	58.7	58.2	60.2
Start Time, msec (25 max.)	10.7	10.9	11.3
Environmental Pressure, psia	.013	.013	.013
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	.00286	.00291	.00288
Total Fuel Flow, lbs	.00220	.00224	.00220
Mean Mixture Ratio, o/f	1.302	1.297	1.311
Pulse Total Impulse, lb-sec	1.3941	1.3749	1.3860
Mean Specific Impulse, sec	275.3	266.7	272.6
Shutdown Impulse, lb-sec (.260 max)*	.2181	.2205	.1981
Cut-Off Time, msec	12.5	14.3	11.9
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.645	.645	.645
Fuel Valve Current, amps	.639	.639	.639
Electrical Power, watts	33.4	33.4	33.4

* Ref: ECN NA-SE6-289R1.

Prepared by:

W. Robinson

Checked by:

[Signature]

Approved for EAT by:

[Signature]

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number 11

Pulse Number			
Signal Width, msec	<u>36.7</u>		
Start Time, msec (25 max.)	<u>12.6</u>		
Environmental Pressure, psia	<u>.013</u>		
Environmental Temperature, °F	<u>70</u>		
Oxidizer Inlet Temperature, °F	<u>70</u>		
Fuel Inlet Temperature, °F	<u>70</u>		
Oxidizer Inlet Pressure, psia	<u>292</u>		
Fuel Inlet Pressure, psia	<u>292</u>		
Total Oxidizer Flow, lbs	<u>.00186</u>		
Total Fuel Flow, lbs	<u>.00148</u>		
Mean Mixture Ratio, o/f	<u>1.251</u>		
Pulse Total Impulse, lb-sec	<u>.8362</u>		
Mean Specific Impulse, sec	<u>250.3</u>		
Shutdown Impulse, lb-sec (.260 max) *	<u>.2410</u>		
Cut-Off Time, msec	<u>.14.9</u>		
Oxidizer Valve Voltage, volts	<u>26</u>		
Fuel Valve Voltage, volts	<u>26</u>		
Oxidizer Valve Current, amps	<u>.645</u>		
Fuel Valve Current, amps	<u>.639</u>		
Electrical Power, watts	<u>33.4</u>		

* Ref: ECN NA-SE6-289R1

Prepared by:

W. Robinson

Checked by:

[Signature]

Approved for JPL by:

[Signature]

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>15</u>	Site Data	Standard Vacuum
Pulse Number <u>4</u>		
Firing Duration, sec	<u>.696</u>	
Accumulated Firing Time, sec	<u>78.1</u>	
Data Slice Number	<u>5</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.013</u>	0
Environmental Temperature, °F	<u>64 (VAC. chamber)</u>	
Oxidizer Temperature, °F	<u>64</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>294.4</u>	292
Fuel Inlet Pressure, psia	<u>294.5</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0474</u>	<u>.0469</u>
Fuel Flowrate, lbs/sec	<u>.0355</u>	<u>.0353</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.34</u>	<u>1.33</u>
Thrust, lbs (23.0±5%)	<u>23.8</u>	<u>23.7</u>
Specific Impulse	<u>287</u>	<u>288</u>
Start Time, msec (25 max)	<u>18</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.1827</u>	
Oxidizer Valve Voltage, volts	<u>25.8</u>	
Fuel Valve Voltage, volts	<u>25.4</u>	
Oxidizer Valve Current, amps	<u>.631</u>	
Fuel Valve Current, amps	<u>.609</u>	
Electrical Power, watts	<u>31.8</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved for NAA by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number 17

Pulse Number			
Signal Width, msec	<u>8</u>		
Start Time, msec (25 max.)	<u>58.6</u>		
Environmental Pressure, psia	<u>11.5</u>		
Environmental Temperature, °F	<u>.013</u>		
Oxidizer Inlet Temperature, °F	<u>70</u>		
Fuel Inlet Temperature, °F	<u>70</u>		
Oxidizer Inlet Pressure, psia	<u>70</u>		
Fuel Inlet Pressure, psia	<u>292</u>		
Total Oxidizer Flow, lbs	<u>292</u>		
Total Fuel Flow, lbs	<u>.00277</u>		
Mean Mixture Ratio, o/f	<u>.00217</u>		
Pulse Total Impulse, lb-sec	<u>1.276</u>		
Mean Specific Impulse, sec	<u>1.3471</u>		
Shutdown Impulse, lb-sec (.260 max) *	<u>272.9</u>		
Cut-Off Time, msec	<u>222.9</u>		
Oxidizer Valve Voltage, volts	<u>15.9</u>		
Fuel Valve Voltage, volts	<u>26</u>		
Oxidizer Valve Current, amps	<u>26</u>		
Fuel Valve Current, amps	<u>.645</u>		
Electrical Power, watts	<u>.639</u>		
	<u>33.4</u>		

* Ref: ECN NA-SE6-289R1

Prepared by:

H. Robinson

Checked by:

W. J. [Signature]

Approved for NAA by:

[Signature]

FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>23</u>	Site Data	Standard Vacuum
Pulse Number <u>5</u>		
Firing Duration, sec	<u>.1696</u>	
Accumulated Firing Time, sec	<u>123.3</u>	
Data Slice Number	<u>6</u>	
Time of Data Slice, sec	<u>.165</u>	
Environmental Pressure, psia	<u>.013</u>	0
Environmental Temperature, °F	<u>78</u> (vac. chamber)	
Oxidizer Temperature, °F	<u>66</u>	70
Fuel Temperature, °F	<u>67</u>	70
Oxidizer Inlet Pressure, psia	<u>296.5</u>	292
Fuel Inlet Pressure, psia	<u>292.3</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0476</u>	<u>.0468</u>
Fuel Flowrate, lbs/sec	<u>.0357</u>	<u>.0358</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.33</u>	<u>1.31</u>
Thrust, lbs (23.0±5%)	<u>24.0</u>	<u>23.9</u>
Specific Impulse	<u>288</u>	<u>289</u>
Start Time, msec (25 max)	<u>17</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.2353</u>	
Oxidizer Valve Voltage, volts	<u>26.0</u>	
Fuel Valve Voltage, volts	<u>25.6</u>	
Oxidizer Valve Current, amps	<u>.622</u>	
Fuel Valve Current, amps	<u>.606</u>	
Electrical Power, watts	<u>31.6</u>	

*Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved for NAA by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-401 SHEET 101 OF 101

Sequence Number 25

Pulse Number	4	7	
Signal Width, msec	57.9	58.1	
Start Time, msec (25 max.)	10.9	10.9	
Environmental Pressure, psia	.013	.013	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	
Fuel Inlet Pressure, psia	292	292	
Total Oxidizer Flow, lbs	.00274	.00276	
Total Fuel Flow, lbs	.00217	.00215	
Mean Mixture Ratio, o/f	1.262	1.280	
Pulse Total Impulse, lb-sec	1.3040	1.3394	
Mean Specific Impulse, sec	265.9	272.6	
Shutdown Impulse, lb-sec (.260 max) *	.2149	.2185	
Cut-Off Time, msec	20.3	20.0	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.645	.645	
Fuel Valve Current, amps	.639	.639	
Electrical Power, watts	33.4	33.4	

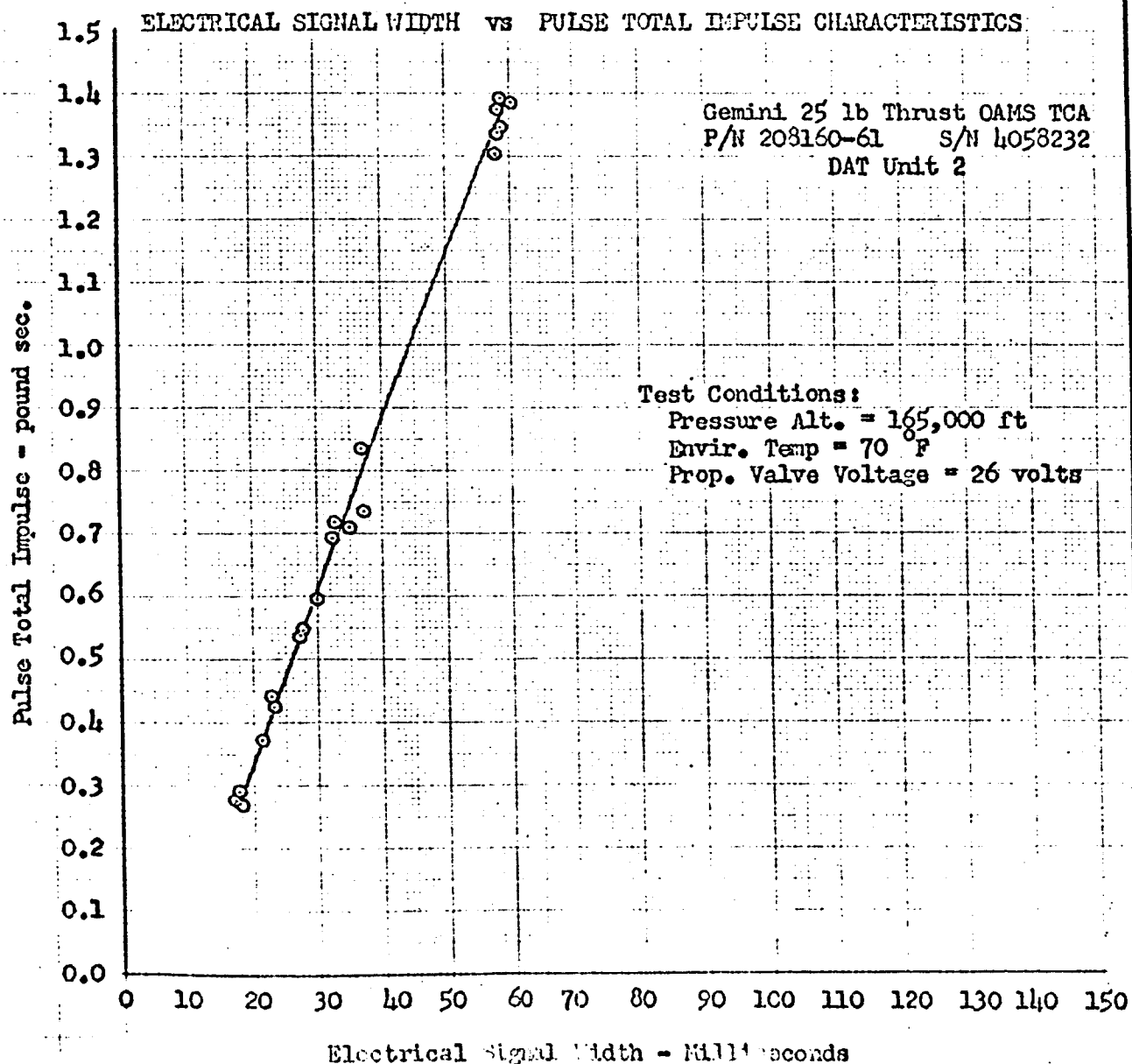
*Ref: ECN NA-SE6-289R1

Prepared by: <i>W. Robinson</i>	Checked by: <i>W. J. McArthur</i>	Approved for NAA by: <i>R. H. G. G.</i>
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FORM 600-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
TEST NO. _____ DAT DUTY CYCLE TO 160 SECONDS SHEET _____ OF _____



FORM 608-B-40 NEW 6-63

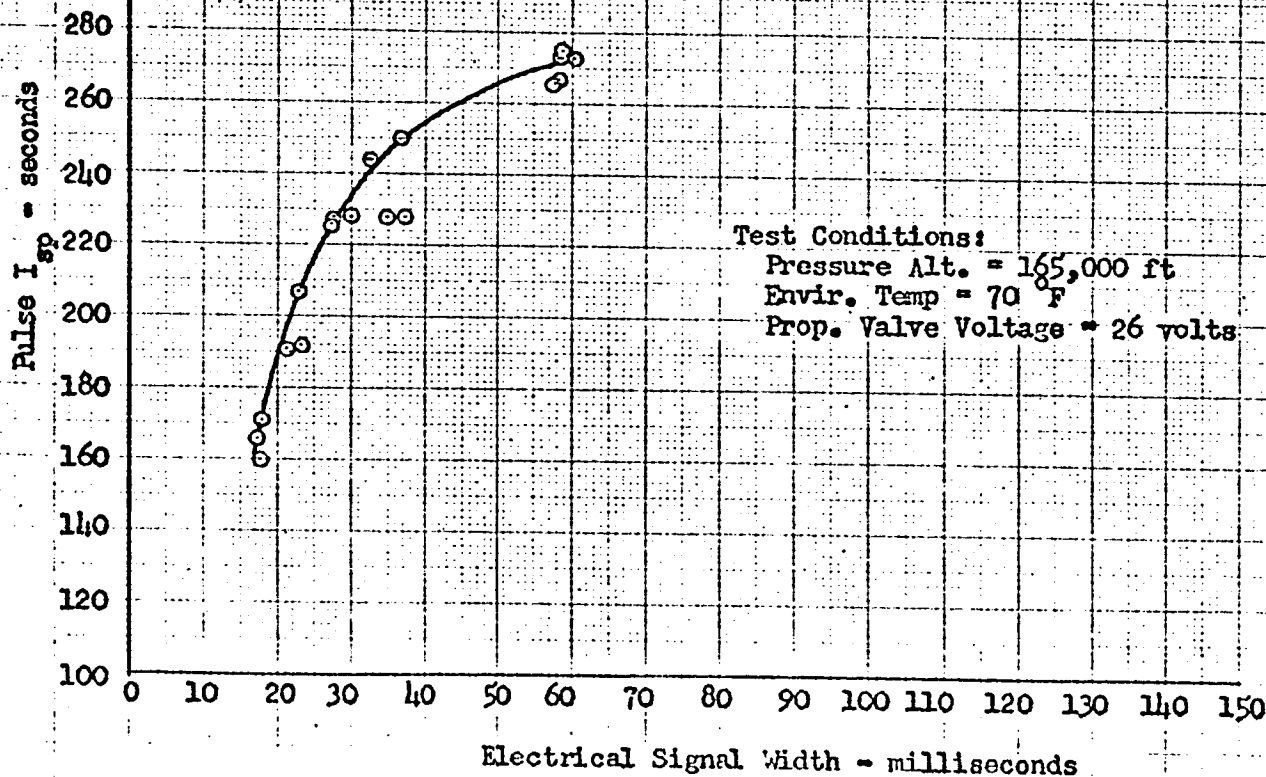
DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
TEST NO. _____ DAT DUTY CYCLE TO 160 SECONDS SHEET _____ OF _____

~~CONFIDENTIAL~~

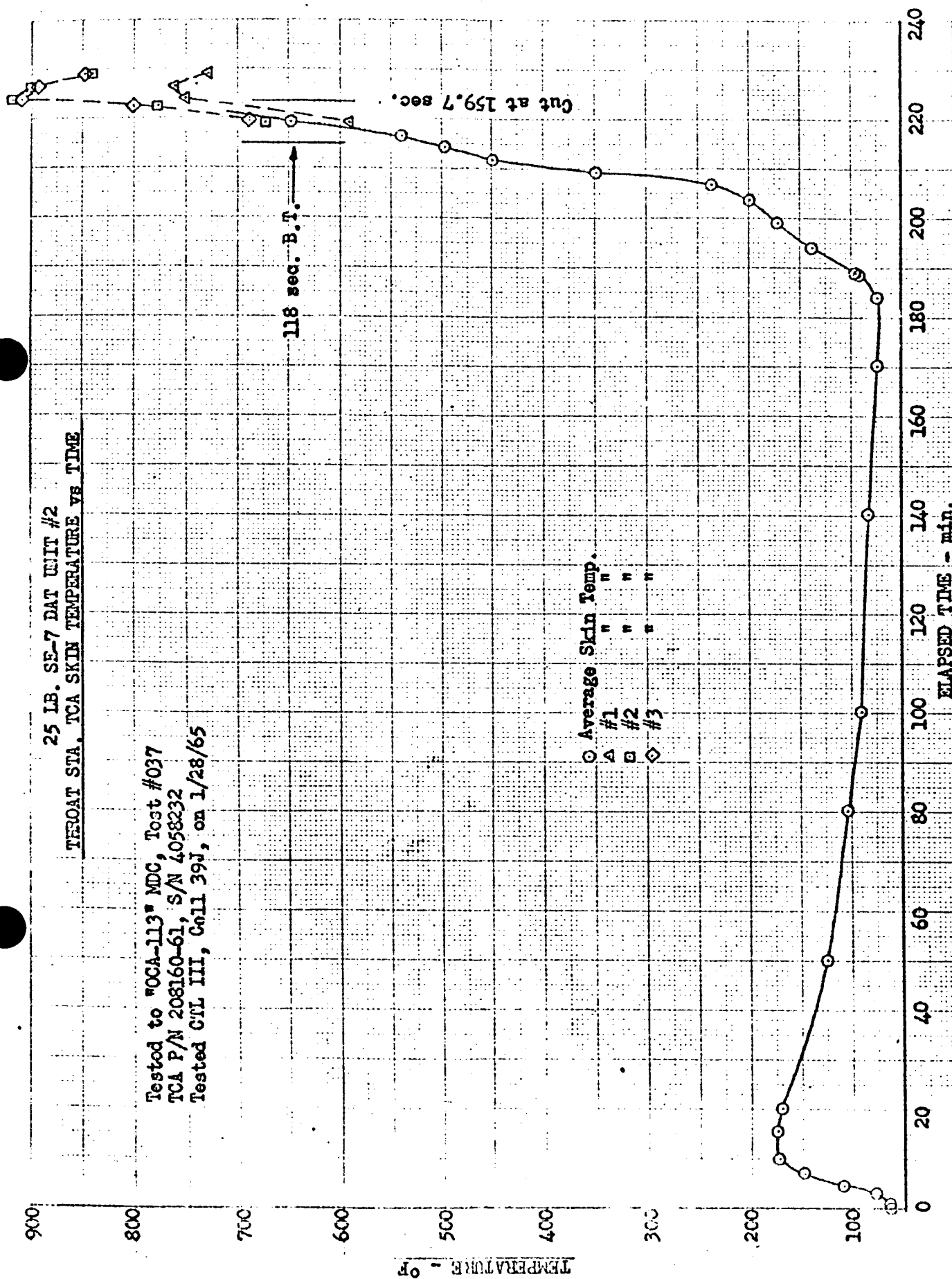
ELECTRICAL SIGNAL WIDTH vs PULSE SPECIFIC IMPULSE CHARACTERISTICS

Gemini 25 lb Thrust OAMS TCA
P/N 208160-61 S/N 4058232
DAT Unit 2



FORM 608-B-40 NEW 6-63

~~CONFIDENTIAL~~



ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY-25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST IAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-401 SHEET 401 OF 401

8 February, 1965

Deviation Request:

The Hot-Fire Test data (paragraphs 7.2.3 and 7.2.4) will be completed when data is available. Proceed with Weight Determination (paragraphs 6.6 and 7.2.4.3) for TCA P/N 208160-61 S/N 4058232.

All other testing has been completed on this TCA.

R. Cole

R. Cole
Gemini IAT-RAT Unit

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

2-8-65

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 160 SECONDS TEST NO. 208160-401 SHEET 329 OF 380

7.2.4.3

Weight Determination Test (reference paragraph 6.6)

All protective closures were removed from the TCA.

YES (Yes or No)

The TCA dry weight was 2.98 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

NONE 2-9-65

PREPARED BY <u>EA</u> E. Adams	DATE <u>1/10/64</u>	PERFORMED BY <u>T.S. Pope</u>	DATE <u>2-9-65</u>	WITNESSED FOR NAA <u>P. Rayl</u>	DATE <u>2-9-65</u>	CERTIFIED FOR McDONNELL <u>WHIVED BY</u>	DATE <u>2-9-65</u>
				VERIFIED BY USAF <u>CFM</u>			

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

IL 5388-6158

INTERNAL LETTER

North American Aviation, Inc.

DATE

5 April 1965

TO

Those Concerned

FROM

Gemini DAT Unit

Address

Address

D/896-388

SUBJECT

Deviation to DAT Specification 208160-401

REFERENCE

OFR 12924R and 32656R

Failure analysis on 25 lb OMS Gemini DAT TCA P/N 208160-61, S/N 4058232, shall satisfy the DAT specification requirements of disassembly and inspection.

During the failure analysis, all disassembly and inspection requirements of the DAT specification shall be accomplished in order to eliminate the added operation of returning the hardware from failure analysis to DAT.

R. Cole

R. Cole
Gemini DAT Unit

Approved: *R. L. Free*
R. L. Free
MAC Engineering

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 330 OF 380

Reference: MAC SCD 52-52701, Revision , Paragraph 6.2.3.20

7.2.5 Disassembly and Inspection

7.2.5.1 Test Procedure

7.2.5.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.2.5.1.2 Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 11. All cutting shall be done by saw. C

7.2.5.1.3 Separate the propellant valves from the mounting bracket. C

7.2.5.1.4 Section the TCA by cutting along line C-D-E as depicted in Figure 11.

7.2.5.1.5 Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatibility, corrosion, broken parts and impending failure.

7.2.5.1.6 After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C

7.2.5.1.7 Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407664 shall not be removed at this time.

7.2.5.1.8 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish this shall be removed. The filter assembly P/N NA5-28097-17 shall not be removed at this time. C

PREPARED BY: R. Cole	DATE 11-30-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 11-30-64	APPROVED FOR McDONNELL: <i>[X]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 11-30-64				

FORM 608-B-38 NEW 6-63

Rev. C *[Signature]* Date 12-1-64

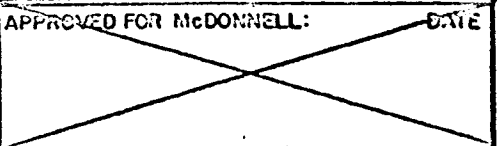
ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 28160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 330 OF 380

- 7.2.5.1.9 Remove, bag and identify the seat assembly.
- 7.2.5.1.10 Remove, bag and identify the armature P/N 407569.
- 7.2.5.1.11 Remove, bag and identify the spring P/N 406806.
- 7.2.5.1.12 Remove, bag and identify the filter assembly.
- 7.2.5.1.13 Bag and identify the solenoid assembly.
- 7.2.5.1.14 Repeat 7.2.5.1.7 thru 7.2.5.1.13 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY:	DATE:	APPROVED FOR NAA:	DATE:	APPROVED FOR McDONNELL:	DATE:
R. Cole		<i>R. Cole</i>	11-30-64		
CHECKED BY:	DATE:				
<i>J. D. [Signature]</i>	11-30-64				

FORM 608-B-38 NEW 6-63

Rev. C *J. D. [Signature]* Date 12-1-64

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-101 SHEET 331 OF 380

7.2.5.2 Post Test Inspection Data - TCA #2

7.2.5.2.1 Component Identification

Component Name TCA
McDonnell Part No. 52-52701-265
Rocketdyne Part No. 208160-61
Component Serial No. 4058232

7.2.5.2.2 Preliminary Inspection (Reference paragraph 7.2.5.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows:

*ABLATIVE SEPARATION AT EXIT
1' DOWNSTREAM OF THROAT 1ST LINE. FROM THROAT INSERT
ISOLATED PLACES. LINERS & THROAT HAVE HEAVY RINGING
OF C-RING. HEAVY DISCOLORATION OF SHELL & FLANGE. A
POSSIBLE CRACKING OF THROAT-IMPOSSIBLE TO VERIFY BECAUSE OF
C-DRUMS (ALSO TRUE FOR LINERS) 4-14-65, A-101*

7.2.5.2.3 Disassembly and Inspection (Reference paragraph 7.2.5.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows: *ABLATIVE SEPARATIONS ON CHAMBER SEGMENT APPROX 10 PLACES. NOZZLE SEPARATED FROM CHAMBER SEGMENT, THROAT INSERT IN 3 PIECES DUE TO THROAT INSERT BEING CRACKED BEFORE SECTIONING. SLEEVE HEAVILY CHARRED & CHIPPED AT AREA NEXT TO THROAT. NOZZLE HAS SEPARATIONS PLCS.*

PREPARED BY <u>E. Adams</u>	DATE <u>7-16-64</u>	PERFORMED BY <u>J. Bishop</u>	DATE <u>5-5-65</u>	WITNESSED FOR NAA <u>[Signature]</u>	DATE <u>5-5-65</u>	CERTIFIED FOR McDonnell <u>[Signature]</u>	DATE <u>5-5-65</u>
				VERIFIED BY USAF <u>[Signature]</u>			

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 331 OF 320

7.2.5.2.4 Disassembly of Propellant Valves (Reference Paragraphs 7.2.5.1.7 thru 7.2.5.1.13 .)

The propellant valves were disassembled and all parts called for were bagged and identified YES (yes or no).

PREPARED BY D, Cole	DATE	PERFORMED BY <i>C. J. Houtz</i> 5-7-65	DATE	WITNESSED FOR NAA <i>JR Sutherland</i> 5/7/65	DATE	CERTIFIED FOR McDONNELL <i>J. Smith</i> 5/7/65	DATE	CERTIFIED BY USAF <i>[Signature]</i> 5/7/65	DATE
-------------------------------	------	---	------	--	------	---	------	--	------

FORM 608-B-39 NEW 6-63

Rev. C. J. D. M. Date 12-1-64
B-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST ENVIRONMENT AND SERVICE LIFE TESTS TEST NO. 208160-401 SHEET 332 OF 380

Reference: MAC SCD 52-52701, Revision F, Figure 12.

7.3 Thrust Chamber Assembly No. 3

This subsection specifies the tests which are to be performed on Thrust Chamber Assembly No. 3.

PREPARED BY: <u>Ed</u> DATE <u>4/10/64</u>	APPROVED FOR NAA: <u>[Signature]</u> DATE <u>4-13-64</u>	APPROVED FOR McDONNELL: <u>[Signature]</u> DATE <u>4-13-64</u>
CHECKED BY: <u>[Signature]</u> DATE <u>4-13-64</u>		

FORM 600-B-30 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-401 SHEET 333 OF 380

Reference: MAC SCD 52-52701, Revision F, paragraph 6.2.2.1

7.3.1 Pre-Test Inspection - TCA #3

7.3.1.1 Test Procedure

7.3.1.1.1 Verify that the TCA is of the proper configuration and has passed the Acceptance Test of Rocketdyne Specification RAO220-354. Only the TCA's that comply with the above requirement shall be accepted for DAT.

7.3.1.1.2 Record the Rocketdyne Part Number and Serial Number of the TCA.

7.3.1.1.3 Record the Rocketdyne Part Number and Serial Number of the oxidizer propellant valve.

7.3.1.1.4 Record the Rocketdyne Part Number and Serial Number of the fuel propellant valve.

7.3.1.1.5 Record the McDonnell Part Number of the TCA.

7.3.1.1.6 Inspect the TCA for visual evidence of damage or deterioration. Comment on all visual defects.

7.3.1.1.7 Braze propellant valve inlet adapters to the fuel and oxidizer inlet tube stubs as defined in Rocketdyne Process Specification RAO607-009.

7.3.1.1.8 Perform Weight Determination of paragraph 6.6.

PREPARED BY: E. Adams	DATE 7-16-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 8-4-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 8-3-64				


FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**


COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-401 SHEET 33 OF 380

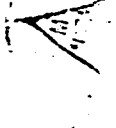
7.3.1.2 Test Data - TCA #3

7.3.1.2.1 Component Identification


Component Name	TCA	Oxidizer Valve	Fuel Valve
McDonnell Part No.	<u>52-52701-265</u>		
Rocketdyne Part No.	<u>208160-61</u>	<u>407539</u>	<u>407560</u> 
Component Serial No.	<u>4057532</u>	<u>4057735</u>	<u>4055173</u>


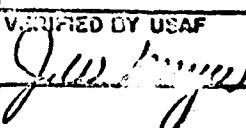
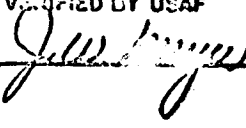
7.3.1.2.2 Inspection (reference paragraph 7.3.1.1)

7.3.1.2.2.1 The TCA was inspected and found to be of the proper configuration and has passed the Acceptance Tests of RA0220-354. YES (yes or no) 

7.3.1.2.2.2 Propellant Valve inlet adapters were installed on the propellant valves per paragraph 7.3.1.1.7 YES (yes or no) 

7.3.1.2.2.3 Inspection Remarks

PROPELLANT VALVE INLET ADAPTERS
WERE INSTALLED PER RA0607-009
INFORMATION ONLY 10-6-64 

PREPARED BY E. Adams	DATE 7-16-64	PERFORMED BY 	DATE 10/15/64	WITNESSED FOR NAA Eugene Frisvold	DATE 10/15/64	CERTIFIED FOR McDONNELL WRITTEN BY ROCKETDYNE 	DATE 10/15/64
				VERIFIED BY USAF 			

FORM 608-B-39 NEW 6-63

Rev A _____ Date _____

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PRE-TEST INSPECTION TEST NO. 208160-401 SHEET 335 OF 380

7.3.1.2.3 Weight Determination Test Data (reference paragraph 6.6)

All protective closures were removed from the TCA.

YES (Yes or No)

The TCA dry weight was 3.12 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks

NONE

PREPARED BY <u>EA</u> E. Adams	DATE <u>11/1/64</u>	PERFORMED BY <u>H. Z. Page</u>	DATE <u>10-7-64</u>	WITNESSED FOR NAA <u>[Signature]</u>	DATE <u>10-7-64</u>	CERTIFIED FOR McDONNELL WAIVED BY <u>J. MARCOENIS</u> VERIFIED BY USAF <u>Robert M. [Signature]</u>	DATE <u>10-7-64</u>
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FORM 608-B-39 REV 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 203160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 203160-701 336 OF 380
SHEET

Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.2.2

7.3.2 DAT Duty Cycle to 118 Seconds - TCA #3

7.3.2.1 Test Procedure

7.3.2.1.1 Perform fuel and oxidizer propellant valve orifice removal per paragraph 6.9.

7.3.2.1.2 Install fuel and oxidizer propellant valve orifice adapter (99-106728) in the facility propellant feed system (See Figure 6).

7.3.2.1.3 Install fuel and oxidizer valve metering orifice and retaining ring in the facility mounted orifice adapter.

7.3.2.1.4 Adjust instrumentation ranges per Table I and Note 6.

7.3.2.1.5 Perform Cape Cycle Firing Test per paragraph 6.7.

7.3.2.1.5.1 Make a one-second firing followed by another one-second firing five minutes later.

7.3.2.1.5.2 Wait ten minutes and make a one-second firing followed by another one-second firing five minutes later.

7.3.2.1.5.3 Repeat paragraph 7.3.2.1.5.2.

7.3.2.1.6 Wait for TCA skin temperature to return to ambient temperature (70 \pm 20F). Perform DAT Duty Cycle Firing Test per paragraph 6.7, and Table II. The TCA shall demonstrate specification performance for a minimum accumulated firing time of 118 seconds.

7.3.2.1.7 Maintain pressure altitude and monitor TCA exterior wall temperature until peak temperature is reached. The maximum allowable temperature shall not exceed 650 F.

PREPARED BY: R. Colo	DATE 9-17-64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 10-8-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE 10-3-64				

FORM 603-B-53 NEW 6-63


ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-701 336.1 SHEET OF 380

NOTE: Do not reduce altitude or remove the TCA from the test stand. Perform the procedures of paragraph 7.3.3.1.1 thru 7.3.3.1.3 during TCA temperature soakout period of 20 \pm 5 minutes. Within 5 minutes after peak temperature is reached complete the procedures of paragraphs 7.3.3.1.4 thru 7.3.3.1.10.

- 7.3.2.1.8 Reduce data per SEM 4388-4040.
- 7.3.2.1.8.1 The results of significant data shall include but not be limited to the following:
- 7.3.2.1.8.1.1 Graphical presentation of temperature versus time for all TCA thermocouple locations including soakout period.
- 7.3.2.1.8.1.2 Graphical presentation of total impulse versus signal width.
- 7.3.2.1.8.1.3 Graphical presentation of mean specific impulse versus signal width.
- 7.3.2.1.9 Perform weight determination per paragraph 6.6.

PREPARED BY: E. Adams	DATE 10-9-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: R Cole	DATE 10-9-64				

FORM 603-2-38 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-401 SHEET 337 OF 380

7.3.2.2 Test Data - TCA #3

7.3.2.2.1 Component Identification

Component Name

SE7 TCA 25#

McDonnell Part No.

52-52701-265

Rocketdyne Part No.

208160-61

Component Serial No.

4052532

Accumulated Acceptance Test Firing Time, seconds 60 sec

Pro-Test

Throat Diameter, inches
(Average of four measurements)

1.3576

Nozzle Exit Diameter, inches

2.250

7.3.2.2.2

Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	<u>11-264</u>	<u>11-2-64</u>
Sample Batch Number	<u>11-2</u>	<u>11-1</u>
Sample Temperature, F	<u>60°</u>	<u>77°</u>
Sample Specific Gravity	<u>1.461</u>	<u>873</u>
Met Mil Spec. Requirements (Yes or No)	<u>YES</u>	<u>YES</u>

PREPARED BY <u>E. Adams</u>	DATE <u>4/10/64</u>	PERFORMED BY <u>R. Allen</u>	DATE <u>11-4-64</u>	WITNESSED FOR NAA <u>DMO</u>	DATE <u>4/10/64</u>	CERTIFIED FOR McDONNELL <u>Waived Via Tele-con</u>	DATE <u>4/10/64</u>
				VERIFIED BY U.S.A.			

FORM 1055-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 257 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DUTY CYCLE TO 118 SECONDS TEST NO. 208160-101 SHEET 338 OF 320

7.3.2.2.3 Cape Cycle Test (reference paragraph 7.3.2.1)

Test Cell Location CTL-3

Test Cell Number 39-1

Test Number 135

Test Date 11-3-64

	Pulse Duration (sec) (1.000 ± .020 sec)	Time between Pulses, (minutes)
1st Pulse	<u>.989</u>	<u>5</u> (5)
2nd Pulse	<u>.987</u>	<u>10</u> (10)
3rd Pulse	<u>.987</u>	<u>5</u> (5)
4th Pulse	<u>.986</u>	<u>10</u> (10)
5th Pulse	<u>.986</u>	<u>5</u> (5)
6th Pulse	<u>.986</u>	<u>—</u>
Accumulated Firing Time, seconds <u>5.92</u>		

PREPARED BY R. Colo.	DATE 	PERFORMED BY E. S. Hrubben	DATE 11/3/64	WITNESSED FOR NAA [Signature]	DATE 11/3/64	CERTIFIED FOR McDONNELL [Signature]	DATE
						VERIFIED BY USAF 	DATE

FORM 608-B-39 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 254 PART NO. MAC 52-52701- 265
NAA208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-401 SHEET 332 OF 389

7.3.2.2.3 Duty Cycle Test (reference paragraph 7.3.2.1)

Test Cell Location CTL-3 ANK 930
Test Cell Number 37.5 ANK 930
Test Number 126 ANK 930
Test Date 11-3-64 ANK 930

The fuel and oxidizer propellant valve orifices were removed from the TCA per paragraph 6.9. YES (yes or no)

The fuel and oxidizer propellant valve orifice adapters were installed in the facility feed system. YES (yes or no)

The fuel and oxidizer propellant valve metering orifices were installed in the facility mounted orifice adapters. YES (yes or no)

PREPARED BY	DATE	PERFORMED BY	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR McDONNELL	DATE
E. Adams	9-15-64	E. S. Hibben	11/3/64	D. J. Kelly		D. D. Marzani	12/18/64
						VERIFIED BY	DATE
							12/14/64

FORM 604-2-39 REV 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM.

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 203160 SHEET 101 OF 101

Sequence Number 1

Pulse Number	3	16	24
Signal Width, msec	36.3	37.1	37.0
Start Time, msec (25 max.)	10.1	10.3	8.8
Environmental Pressure, psia	.022	.022	.022
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	8365	8517	8738
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max)**	1616	1320	1504
Cut-Off Time, msec	10.9	10.0	10.2
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.659	.659	.659
Fuel Valve Current, amps	.642	.642	.642
Electrical Power, watts	33.8	33.8	33.8

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by:

R. J. Johnson

Checked by:

R. J. Johnson

Approved for test by:

R. J. Johnson

FORM 608-B-37 REV 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25A PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>2</u>	Site Data	Standard Vacuum
Pulse Number <u>1</u>		
Firing Duration, sec	<u>4.2</u>	
Accumulated Firing Time, sec	<u>21.0</u>	
Data Slice Number	<u>1</u>	
Time of Data Slice, sec	<u>4.0</u>	
Environmental Pressure, psia	<u>.022</u>	0
Environmental Temperature, °F	<u>65 (VAC. chamber)</u>	
Oxidizer Temperature, °F	<u>65</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>285.4</u>	292
Fuel Inlet Pressure, psia	<u>294.7</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0455</u>	<u>.0461</u>
Fuel Flowrate, lbs/sec	<u>.0336</u>	<u>.0332</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.35</u>	<u>1.39</u>
Thrust, lbs (23.0±5%)	<u>22.4</u>	<u>22.6</u>
Specific Impulse (272 min.)	<u>284</u>	<u>285</u>
Start Time, msec (25 max)	<u>13</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.1724</u>	
Oxidizer Valve Voltage, volts	<u>29.1</u>	
Fuel Valve Voltage, volts	<u>28.2</u>	
Oxidizer Valve Current, amps	<u>.700</u>	
Fuel Valve Current, amps	<u>.679</u>	
Electrical Power, watts	<u>39.5</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved by: NAA by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 254 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT INTX CYCLE TO 118 SECONDS TEST NO. 201160-101 SHEET 101 OF 101

Sequence Number <u>3</u>	Site Data	Standard Vacuum
Pulse Number <u>1</u>		
Firing Duration, sec	<u>.690</u>	
Accumulated Firing Time, sec	<u>22</u>	
Data Slice Number	<u>2</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.022</u>	0
Environmental Temperature, °F	<u>65 (vac. chamber)</u>	
Oxidizer Temperature, °F	<u>65</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>285.4</u>	292
Fuel Inlet Pressure, psia	<u>294.7</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0461</u>	<u>.0468</u>
Fuel Flowrate, lbs/sec	<u>.0359</u>	<u>.0354</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.29</u>	<u>1.32</u>
Thrust, lbs (23.0±5%)	<u>22.8</u>	<u>23.0</u>
Specific Impulse	<u>279</u>	<u>280</u>
Start Time, msec (25 max)	<u>15</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.17675</u>	
Oxidizer Valve Voltage, volts	<u>29.3</u>	
Fuel Valve Voltage, volts	<u>28.3</u>	
Oxidizer Valve Current, amps	<u>.690</u>	
Fuel Valve Current, amps	<u>.673</u>	
Electrical Power, watts	<u>39.3</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Appr:

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-SHEET OF

Sequence Number 4

Pulse Number	2	8	26
Signal Width, msec	20.3	20.4	20.5
Start Time, msec (25 max.)	10.1	10.3	10.9
Environmental Pressure, psia	.022	.022	.022
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	4779	4329	4089
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max) **	1913	1720	1475
Cut-Off Time, msec	13.5	12.4	10.6
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.659	.659	.659
Fuel Valve Current, amps	.642	.642	.642
Electrical Power, watts	33.8	33.8	33.8

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by:

H. Robinson

Checked by:

[Signature]

Approved for IMA by:

[Signature]

FORM EOC-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-401 SHEET 101 OF 101

Sequence Number <u>5</u>	Site Data	Standard Vacuum
Pulse Number <u>3</u>		
Firing Duration, sec	<u>.690</u>	
Accumulated Firing Time, sec	<u>26.5</u>	
Data Slice Number	<u>3</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.022</u>	0
Environmental Temperature, °F	<u>67</u> (vac. chamber)	
Oxidizer Temperature, °F	<u>65</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>285.4</u>	292
Fuel Inlet Pressure, psia	<u>293.7</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0461</u>	<u>.0468</u>
Fuel Flowrate, lbs/sec	<u>.0359</u>	<u>.0355</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.29</u>	<u>1.32</u>
Thrust, lbs (23.0±5%)	<u>23.0</u>	<u>23.2</u>
Specific Impulse	<u>280</u>	<u>282</u>
Start Time, msec (25 max)	<u>14</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.1624</u>	
Oxidizer Valve Voltage, volts	<u>29.6</u>	
Fuel Valve Voltage, volts	<u>28.6</u>	
Oxidizer Valve Current, amps	<u>.684</u>	
Fuel Valve Current, amps	<u>.667</u>	
Electrical Power, watts	<u>39.3</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

Approved for NAA by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
101
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-SHEET OF 101

Sequence Number 6

Pulse Number	3	14	
Signal Width, msec	23.7	23.5	
Start Time, msec (25 max.)	11.0	11.2	
Environmental Pressure, psia	.022	.022	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	
Fuel Inlet Pressure, psia	292	292	
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	.5100	.4898	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max)**	.1832	.1678	
Cut-Off Time, msec	9.5	8.4	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.659	.659	
Fuel Valve Current, amps	.642	.642	
Electrical Power, watts	33.8	33.8	

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by: <i>W. Robinson</i>	Checked by: <i>[Signature]</i>	Approved for NAA by: <i>[Signature]</i>
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FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160 SHEET 101 OF 101

Sequence Number 7

Pulse Number	17	101	
Signal Width, msec	36.1	37.1	
Start Time, msec (25 max.)	13.0	13.1	
Environmental Pressure, psia	.022	.022	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	
Fuel Inlet Pressure, psia	292	292	
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	.8166	.8382	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max) **	.1832	.1867	
Cut-Off Time, msec	9.7	10.4	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.659	.659	
Fuel Valve Current, amps	.642	.642	
Electrical Power, watts	33.8	33.8	

* Flows Unreadable - Instrumentation Problems

** Ref: EON NA-SE6-289R1

Prepared by: W. Robinson Checked by: [Signature] Approved for NAA by: [Signature]

FORM 603-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

Sequence Number <u>8</u>	Site Data	Standard Vacuum
Pulse Number <u>4</u>		
Firing Duration, sec	<u>.690</u>	
Accumulated Firing Time, sec	<u>35.7</u>	
Data Slice Number	<u>4</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.022</u>	0
Environmental Temperature, °F	<u>72</u>	(vac. chamber)
Oxidizer Temperature, °F	<u>65</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>285.4</u>	292
Fuel Inlet Pressure, psia	<u>293.7</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0461</u>	<u>.0468</u>
Fuel Flowrate, lbs/sec	<u>.0359</u>	<u>.0355</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.29</u>	<u>1.32</u>
Thrust, lbs (23.0±5%)	<u>22.4</u>	<u>22.6</u>
Specific Impulse	<u>273</u>	<u>275</u>
Start Time, msec (25 max)	<u>15</u>	
Shutdown Impulse, lb-sec (.260 max)*	<u>.1832</u>	
Oxidizer Valve Voltage, volts	<u>29.4</u>	
Fuel Valve Voltage, volts	<u>28.3</u>	
Oxidizer Valve Current, amps	<u>.679</u>	
Fuel Valve Current, amps	<u>.673</u>	
Electrical Power, watts	<u>39.0</u>	

* Ref: EGN NA-SE6-289R1

Prepared by:

Checked by:

Approved for NAA by:

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 203160
401
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 203160-SHEET OF 101

Sequence Number 9

Pulse Number	2	4	
Signal Width, msec	32.5	32.5	
Start Time, msec (25 max.)	10.1	10.1	
Environmental Pressure, psia	.022	.022	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	
Fuel Inlet Pressure, psia	292	292	
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	.8011	.7727	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max) **	.2046	.1889	
Cut-Off Time, msec	11.7	11.0	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.659	.659	
Fuel Valve Current, amps	.642	.642	
Electrical Power, watts	33.8	33.8	

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by: <u>N. R. Harrison</u>	Checked by: <u>[Signature]</u>	Approved for NAA by: <u>[Signature]</u>
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FORM 608-B-31 CW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
101
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160 SHEET 101 OF 101

Sequence Number 10

Pulse Number	4	8	543
Signal Width, msec	58.5	58.6	58.0
Start Time, msec (25 max.)	8.7	9.0	8.7
Environmental Pressure, psia	.022	.022	.022
Environmental Temperature, °F	70	70	70
Oxidizer Inlet Temperature, °F	70	70	70
Fuel Inlet Temperature, °F	70	70	70
Oxidizer Inlet Pressure, psia	292	292	292
Fuel Inlet Pressure, psia	292	292	292
Total Oxidizer Flow, lbs	*	*	*
Total Fuel Flow, lbs	*	*	*
Mean Mixture Ratio, o/f	*	*	*
Pulse Total Impulse, lb-sec	1.4799	1.4613	1.4327
Mean Specific Impulse, sec	*	*	*
Shutdown Impulse, lb-sec (.260 max)**	.1849	.1898	.1756
Cut-Off Time, msec	11.8	14.7	13.5
Oxidizer Valve Voltage, volts	26	26	26
Fuel Valve Voltage, volts	26	26	26
Oxidizer Valve Current, amps	.659	.659	.659
Fuel Valve Current, amps	.642	.642	.642
Electrical Power, watts	33.8	33.8	33.8

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by: 171. Robinson Checked by: [Signature] Approved for NAA by: [Signature]

FORM 603-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-401 SHEET 101 OF 101

Sequence Number 11

Pulse Number	<u>16</u>		
Signal Width, msec	<u>36.1</u>		
Start Time, msec (25 max.)	<u>10.0</u>		
Environmental Pressure, psia	<u>1022</u>		
Environmental Temperature, °F	<u>70</u>		
Oxidizer Inlet Temperature, °F	<u>70</u>		
Fuel Inlet Temperature, °F	<u>70</u>		
Oxidizer Inlet Pressure, psia	<u>292</u>		
Fuel Inlet Pressure, psia	<u>292</u>		
Total Oxidizer Flow, lbs	<u>*</u>		
Total Fuel Flow, lbs	<u>*</u>		
Mean Mixture Ratio, o/f	<u>*</u>		
Pulse Total Impulse, lb-sec	<u>.8798</u>		
Mean Specific Impulse, sec	<u>*</u>		
Shutdown Impulse, lb-sec (.260 max) **	<u>.2096</u>		
Cut-Off Time, msec	<u>15.4</u>		
Oxidizer Valve Voltage, volts	<u>26</u>		
Fuel Valve Voltage, volts	<u>26</u>		
Oxidizer Valve Current, amps	<u>.659</u>		
Fuel Valve Current, amps	<u>.642</u>		
Electrical Power, watts	<u>33.8</u>		

* Flow Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by: <u>W. Robinson</u>	Checked by: <u>[Signature]</u>	Approved for NAA by: <u>[Signature]</u>
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FORM 608-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-401 SHEET OF

Sequence Number <u>15</u>	Site Data	Standard Vacuum
Pulse Number <u>4</u>		
Firing Duration, sec	<u>.690</u>	
Accumulated Firing Time, sec	<u>73.4</u>	
Data Slice Number	<u>5</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.022</u>	0
Environmental Temperature, °F	<u>75 (vac. chamber)</u>	
Oxidizer Temperature, °F	<u>65</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>283.5</u>	292
Fuel Inlet Pressure, psia	<u>293.7</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0461</u>	<u>.0470</u>
Fuel Flowrate, lbs/sec	<u>.0359</u>	<u>.0356</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.29</u>	<u>1.32</u>
Thrust, lbs (23.0±5%)	<u>22.5</u>	<u>22.8</u>
Specific Impulse	<u>275</u>	<u>276</u>
Start Time, msec (25 max)	<u>14</u>	
Shutdown Impulse, lb-sec (.260 max) *	<u>.2156</u>	
Oxidizer Valve Voltage, volts	<u>29.4</u>	
Fuel Valve Voltage, volts	<u>28.5</u>	
Oxidizer Valve Current, amps	<u>.679</u>	
Fuel Valve Current, amps	<u>.660</u>	
Electrical Power, watts	<u>38.8</u>	

* Ref: ECN NA-SE6-289R1

Prepared by:

Checked by:

FORM 600-1-37 (REV 6-63) 410

R-15019-2

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
LOI
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160 101 SHEET 101 OF 101

Sequence Number 17

Pulse Number	<u>11</u>		
Signal Width, msec	<u>57.7</u>		
Start Time, msec (25 max.)	<u>9.2</u>		
Environmental Pressure, psia	<u>1022</u>		
Environmental Temperature, °F	<u>70</u>		
Oxidizer Inlet Temperature, °F	<u>70</u>		
Fuel Inlet Temperature, °F	<u>70</u>		
Oxidizer Inlet Pressure, psia	<u>292</u>		
Fuel Inlet Pressure, psia	<u>292</u>		
Total Oxidizer Flow, lbs	<u>*</u>		
Total Fuel Flow, lbs	<u>*</u>		
Mean Mixture Ratio, o/f	<u>*</u>		
Pulse Total Impulse, lb-sec	<u>1.4451</u>		
Mean Specific Impulse, sec	<u>*</u>		
Shutdown Impulse, lb-sec (.260 max)**	<u>2377</u>		
Cut-Off Time, msec	<u>15.8</u>		
Oxidizer Valve Voltage, volts	<u>26</u>		
Fuel Valve Voltage, volts	<u>26</u>		
Oxidizer Valve Current, amps	<u>1.659</u>		
Fuel Valve Current, amps	<u>1.642</u>		
Electrical Power, watts	<u>33.8</u>		

* Flows Unreadable - Instrumentation Problems

** Ref: ECN NA-SE6-289R1

Prepared by:

W. J. Johnson

Checked by:

[Signature]

Approved for NAA by:

[Signature]

FORM 008-B-37 NEW 6-63

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-101 SHEET 101 OF 101

	<u>Site Data</u>	<u>Standard Vacuum</u>
Sequence Number <u>23</u>		
Pulse Number <u>4</u>		
Firing Duration, sec	<u>.690</u>	
Accumulated Firing Time, sec	<u>113</u>	
Data Slice Number	<u>6</u>	
Time of Data Slice, sec	<u>.65</u>	
Environmental Pressure, psia	<u>.022</u>	0
Environmental Temperature, °F	<u>85 (vac. chamber)</u>	
Oxidizer Temperature, °F	<u>65</u>	70
Fuel Temperature, °F	<u>65</u>	70
Oxidizer Inlet Pressure, psia	<u>282.5</u>	292
Fuel Inlet Pressure, psia	<u>292.7</u>	292
Oxidizer Flowrate, lbs/sec	<u>.0461</u>	<u>.0472</u>
Fuel Flowrate, lbs/sec	<u>.0359</u>	<u>.0356</u>
Mixture Ratio, o/f (1.30±6%)	<u>1.29</u>	<u>1.33</u>
Thrust, lbs (23.0±5%)	<u>22.1</u>	<u>22.4</u>
Specific Impulse	<u>269</u>	<u>271</u>
Start Time, msec (25 max)	<u>14</u>	
Shutdown Impulse, lb-sec (.260 max)*	<u>.2529</u>	
Oxidizer Valve Voltage, volts	<u>29.4</u>	
Fuel Valve Voltage, volts	<u>28.5</u>	
Oxidizer Valve Current, amps	<u>.662</u>	
Fuel Valve Current, amps	<u>.654</u>	
Electrical Power, watts	<u>38.1</u>	

* Ref: DCN NA-SE6-289R1

Prepared by:

Checked by:

Approved by: NAA by:

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
401
NAME OF TEST DAT DUTY CYCLE TO 118 SECONDS TEST NO. 208160-SHEET OF

Sequence Number 25

Pulse Number	2	7	
Signal Width, msec	58.3	57.8	
Start Time, msec (25 max.)	12.0	10.5	
Environmental Pressure, psia	.022	.022	
Environmental Temperature, °F	70	70	
Oxidizer Inlet Temperature, °F	70	70	
Fuel Inlet Temperature, °F	70	70	
Oxidizer Inlet Pressure, psia	292	292	
Fuel Inlet Pressure, psia	292	292	
Total Oxidizer Flow, lbs	*	*	
Total Fuel Flow, lbs	*	*	
Mean Mixture Ratio, o/f	*	*	
Pulse Total Impulse, lb-sec	1.4110	1.4582	
Mean Specific Impulse, sec	*	*	
Shutdown Impulse, lb-sec (.260 max) *	.2596	.3036	
Cut-Off Time, msec	22.5	22.9	
Oxidizer Valve Voltage, volts	26	26	
Fuel Valve Voltage, volts	26	26	
Oxidizer Valve Current, amps	.659	.659	
Fuel Valve Current, amps	.642	.642	
Electrical Power, watts	33.8	33.8	

* Ref: EGN NA-SE6-289R1

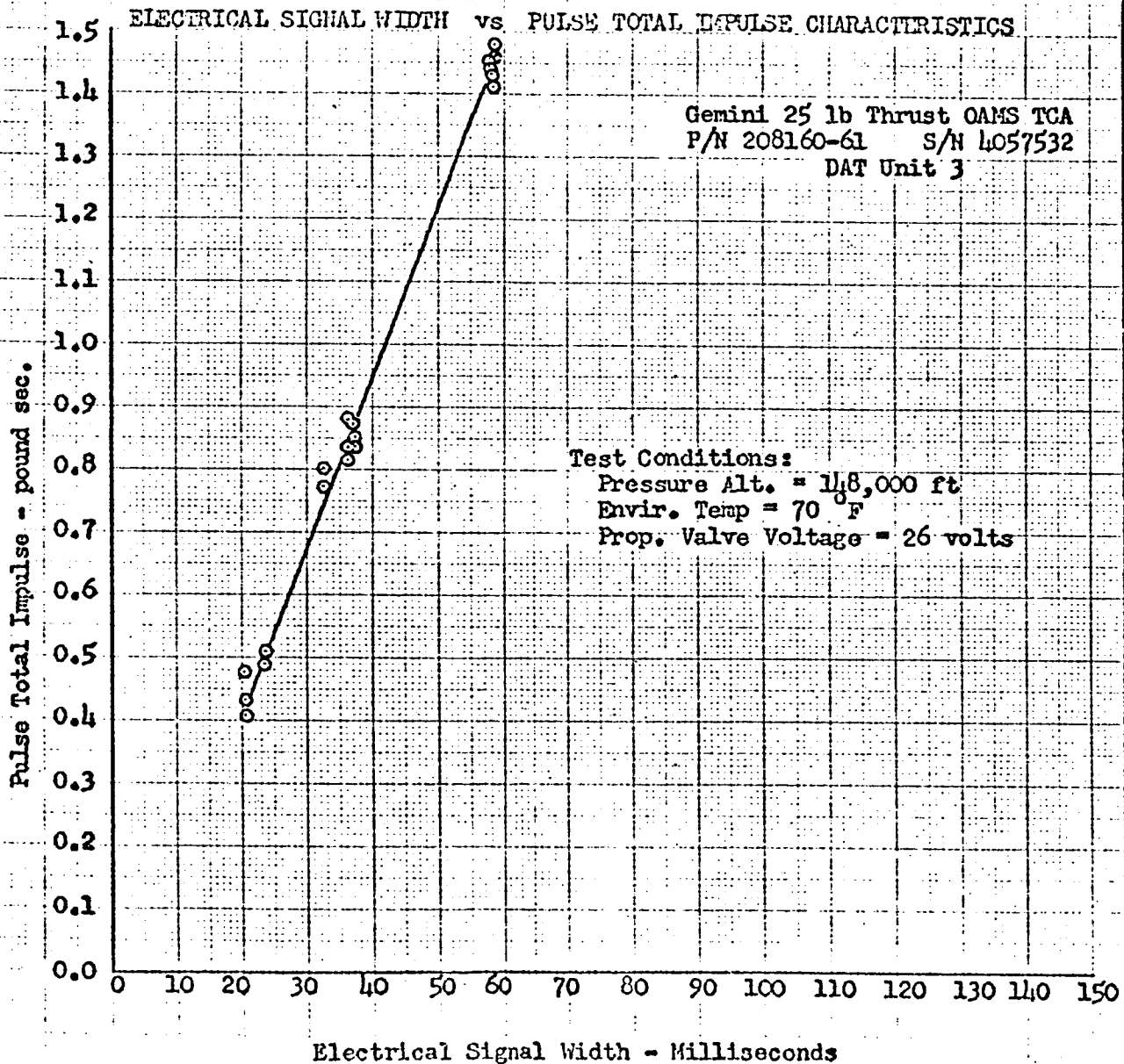
Prepared by: W. L. Harrison Checked by: [Signature] Approved for NAA by: [Signature]

FORM 608-D-37 NEW 5-63

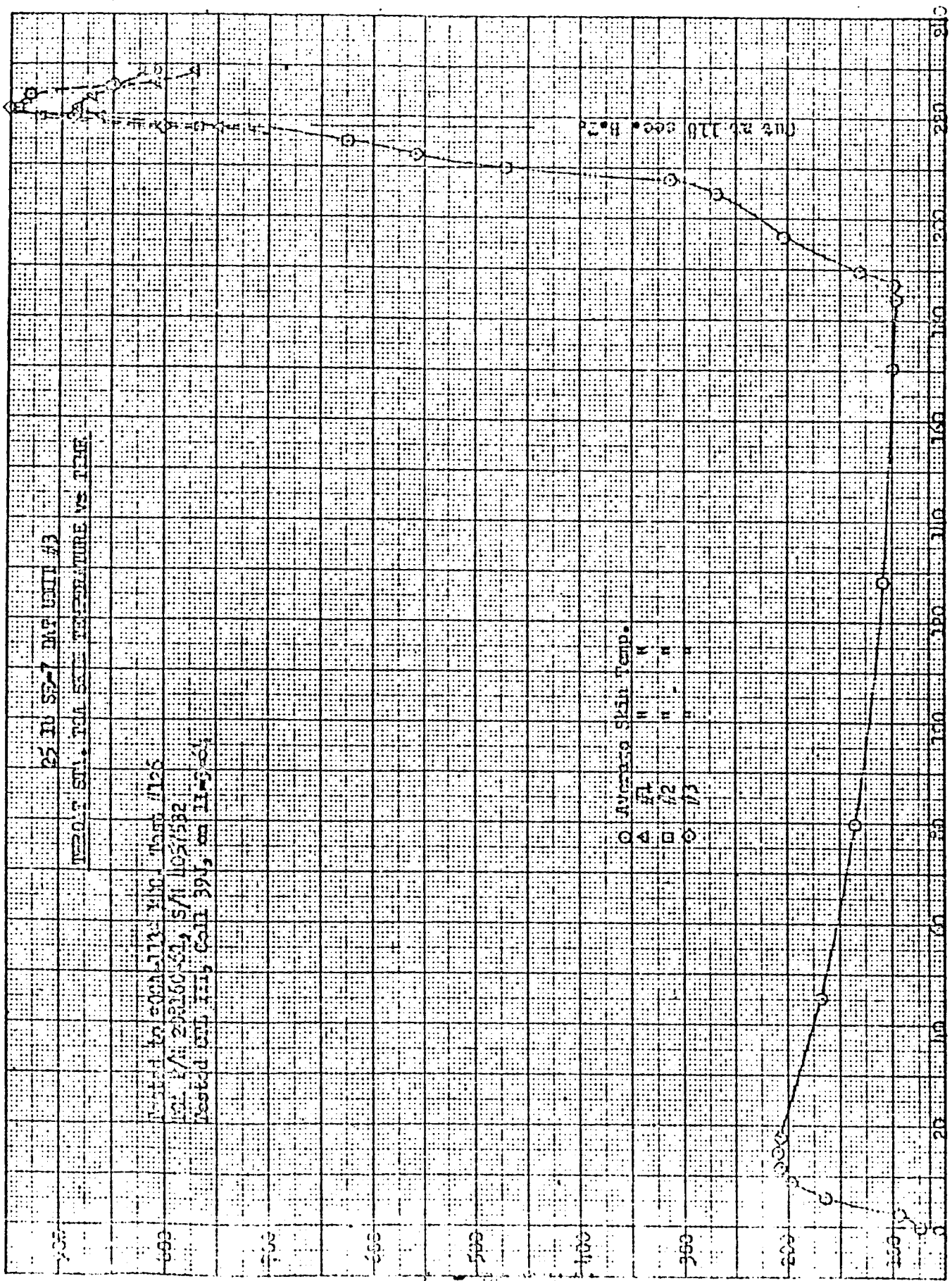
ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160
TEST NO. DAT DUTY CYCLE TO 118 SECONDS SHEET OF



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 10 TO THE CM.
 359T-14
 WELLS & EBBEN CO.
 ALBANY, N.Y.



DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST BURST PRESSURE TEST NO 208160-401 SHEET 1 OF 1

Deviation Request:

The Burst Pressure Test data of paragraph 7.3.3.2.3 will be completed when data is available. Proceed with the Weight Determination of paragraph 6.6 and 7.3.3.2.4.

Recopied from original request dated 12 November 1964.

James D. Mavrogenis
James D. Mavrogenis
MAC Engineering

12-18-64

E. Adams
E. Adams
Gemini Dat-Rat Unit

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 257 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST BURST PRESSURE TEST NO. 208160-401 SHEET 252 OF 300

- Reference: MAC SCD 52-52701, Revision F, paragraph 6.3.1.3.2.2
- 7.3.3 Burst Pressure - TCA #3
- 7.3.3.1 Test Procedure
- 7.3.3.1.1 Open the oxidizer and fuel facility by-pass valves. See Figure 6.
- 7.3.3.1.2 Close the facility propellant valves. See Figure 6.
- 7.3.3.1.3 Adjust the test facility propellant tank pressures to 750 ± 20 psig. The parameters to be recorded during the firing test are combustion chamber exterior wall temperature, facility propellant tank pressures, TCA inlet pressures, and thrust.
- 7.3.3.1.4 Activate instrumentation.
- 7.3.3.1.5 Open the TCA propellant valves.
- 7.3.3.1.6 Within one second after TCA propellant valve opening, open the facility propellant valves simultaneously.
- 7.3.3.1.7 Fire the TCA for three seconds following facility propellant valve opening. The firing test shall be terminated by closing the TCA propellant valves.
- 7.3.3.1.8 The TCA shall demonstrate operation without catastrophic chamber failure as defined in Table II, note 4.
- 7.3.3.1.9 Perform decontamination per paragraph 6.8.
- 7.3.3.1.10 Perform weight determination per paragraph 6.6.
11-13-64

PREPARED BY: J.A. Ganger	DATE 10-6-64	APPROVED FOR NAA: <i>R. Heide</i>	DATE 10-8-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE <i>[Signature]</i>
CHECKED BY: <i>R. Heide</i>	DATE 10-8-64				

FORM 600-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST BURST PRESSURE TEST NO. 208160-401 SHEET 353 OF 380

7.3.3.2 Test Data - TCA #3

7.3.3.2.1 Component Identification

Component Name

McDonnell Part No.

Rocketdyne Part No.

Component Serial No.

Accumulated Acceptance Test Firing Time, seconds

Accumulated Cape Cycle and MDC Firing Time, sec.

Throat Diameter, inches
(Average of four measurements)

Nozzle Exit Diameter, inches

Post Test

0.356

2.235

7.3.3.2.2

Propellant Samples

	Nitrogen Tetroxide	Monomethyl Hydrazine
Sample Date	11-2-64	11-2-64
Sample Batch Number	11-2	11-1
Sample Temperature, F	60°	77°
Sample Specific Gravity	1.461	0.873
Met Mil Spec. Requirements (Yes or No)	Yes	Yes

PREPARED BY E. Adams EA 4/10/64	DATE 11-4-64	PERFORMED BY R. Allen	DATE 11-4-64	WITNESSED FOR NAA [Signature]	DATE 11-4-64	CERTIFIED FOR McDONNELL [Signature] via telecon 11/65	DATE 11-4-64
				VERIFIED BY USAF [Signature]			

FORM 600-2-39 REV 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST BURST PRESSURE TEST NO. 208160-401 SHEET 35 OF 380

7.3.3.2.3

Site Data

Facility oxidizer tank pressure (psig) 750. (750 ⁺⁰ ₋₂₀)
Facility fuel tank pressure (psig) 746. (750 ⁺⁰ ₋₂₀)
Oxidizer inlet pressure (psia) 737.
Fuel inlet pressure (psia) 745.
Thrust (lbs) 55
Combustion chamber exterior wall temperature 835 (700 F max)
Chamber Pressure, calculated, (psia) 1320.

PREPARED BY E. Adams 4/10/64	DATE	PERFORMED BY HR	DATE	WITNESSED FOR NAA [Signature]	DATE	CERTIFIED FOR McDONNELL [Signature]	DATE
VERIFIED BY USAF						DATE	

FORM 600-B-39 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-5211-265
NAA 208160-61
NAME OF TEST BURST PRESSURE TEST NO. 208160-40 SHEET 355 OF 380

7.3.3.2.4 Weight Determination Test Data (reference paragraph (6))

All protective closures were removed from the TCA.

Yes (Yes or No)

The TCA dry weight was 2.89 pounds.
(Record to the nearest one-hundredth pound).

Inspection Remarks



11-13-64

PREPARED BY <u>E. Adams</u> <u>11/10/64</u>	PERFORMED BY <u>D. Fowler</u> <u>11-13-64</u>	WITNESSED FOR NAA <u>J. L. Jones</u> <u>11/13/64</u>	CERTIFIED FOR <u>W. DONNELL</u> DATE <u>11/14/64</u> VERIFIED BY USAF <u>11/13/64</u>
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FORM 608-B-39 NEW 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 256 OF 380

Reference: MAC SCD 52-52701, Revision F, Paragraph 6.2.3.20

7.3.4 Disassembly and Inspection

7.3.4.1 Test Procedure

7.3.4.1.1 Prior to sectioning the TCA perform a visual inspection and record the post test condition of the TCA.

7.3.4.1.2 Cut the propellant valve mounting bracket and propellant valve feed tubes from the TCA injector face along line A, B as shown in Figure 11. All cutting shall be done by saw. C

7.3.4.1.3 Separate the propellant valves from the mounting bracket. C

7.3.4.1.4 Section the TCA by cutting along line C-D-E as depicted in Figure 11.

7.3.4.1.5 Perform visual inspection of all detailed parts for evidence of damage, distortion, fluid incompatibility, corrosion, broken parts and impending failure.

7.3.4.1.6 After test completion identify the sectioned TCA and detailed parts and package and store for reference (except for propellant valves). C

7.3.4.1.7 Machine, on the oxidizer propellant valve, the seat assembly to spacer weld to loosen the seat. Only the minimum amount of material to accomplish this shall be removed. The seat assembly P/N 407664 shall not be removed at this time.

7.3.4.1.8 Machine the filter assembly to solenoid weld to loosen the filter. Only the minimum amount of material to accomplish this shall be removed. The filter assembly P/N NA5-28097-17 shall not be removed at this time. C

PREPARED BY: R. Cole	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>J.A. Sanger</i>	DATE <i>11-30-64</i>	<i>[Signature]</i> <i>11-30-64</i>		<i>[Signature]</i> <i>11-30-64</i>	

FORM 608-B-38 NEW 6-63

Rev. *C. D. Hargrett* Date *12-1-64*

R-15019-2


ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 2-3160-61
401 356.1
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160 SHEET OF 380

- 7.3.4.1.9 Remove, bag and identify the seat assembly.
- 7.3.4.1.10 Remove, bag and identify the armature P/N 407569.
- 7.3.4.1.11 Remove, bag and identify the spring P/N 406806.
- 7.3.4.1.12 Remove, bag and identify the filter assembly.
- 7.3.4.1.13 Bag and identify the solenoid assembly.
- 7.3.4.1.14 Repeat 7.3.4.1.7 thru 7.3.4.1.13 for the fuel propellant valve.

NOTE: Only authorized personnel shall have access to stored DAT hardware.

PREPARED BY:	DATE	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
R. Cole		<i>[Signature]</i>	11-30-64		
CHECKED BY:	DATE				
<i>[Signature]</i>	11-30-64				

FORM 608-B-38 NEW 6-63

Rev. C *[Signature]* Date 12-1-64

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE REENTRY CONTROL SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-101 SHEET 357 OF 380

7.3.4.2 Post Test Inspection Data - TCA #3

7.3.4.2.1 Component Identification

Component Name TCA
McDonnell Part No. SCD52-52700-217
Rocketdyne Part No. 208160-61
Component Serial No. 4657532

7.3.4.2.2 Preliminary Inspection (Reference paragraph 7.3.4.1.1)

The TCA was visually inspected prior to sectioning and the TCA condition was as follows: GENERAL DELAMINATION OF BODY ABLATIVE FROM THROAT TO EXIT END.
SEVERAL DENTS IN SHELL. ALL OF SHELL EXTERIOR IS HEAT DISCOLORED. NIMERATE IS DAMAGED SEVERE THERMAL EROSION OF LINERS & THROAT INSERT.

7.3.4.2.3 Disassembly and Inspection (Reference paragraph 7.3.4.1.3)

The TCA was sectioned along line C-D-E and visually inspected. The results of the inspection were as follows: SEVERE THERMAL EROSION OF FIRST THREE LINERS (ADJACENT TO THROAT)
SOME FLOWING INTO DELAMINATED CAVITIES OF ABLATIVE, SOME FLOWING DOWNSTREAM ON THE THROAT INSERT.
THROAT INSERT HAS A CIRCUMFERENTIAL CRACK HS ENTIRE THICKNESS. ABLATIVE, ABESTOS, GLASS RING, HAS MULTIPLE DELAMINATIONS.

PREPARED BY:	DATE	PERFORMED BY:	DATE	WITNESSED FOR NAA	DATE	CERTIFIED FOR MCDONNELL:	DATE
E. Adams	7-20-64	M. E. Adams	7/8/65	(Signature)	7/8/65	WAIVED BY SECT 78 G. Crumley	7/8/65
						VERIFIED BY USAF:	DATE
						M. A. Halstead	

FORM 608-B-43 NEW 6-63 * ENTERED IN WRONG BLOCK

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-401 SHEET 357 OF 380

7.3.4.2.4. Disassembly of Propellant Valves (Reference Paragraphs 7.3.4.1.7 thru 7.3.4.1.13 .) C

The propellant valves were disassembled and all parts called for were bagged and identified NO (yes or no).

A. FUEL VALVE PIN 407560 SIN 4055173

- ① ARMATURE BALL RETAINER SHOWS SOME WEAR ALSO O.D. OF ARMATURE IS SCRATCHED & PITTED
- ② BALL - IS RUSTY, SCRATCHED & CONTAMINATED
- ③ FILTER - NO DEFECTS NOTED
- ④ TELFON SEAT - DISCOLORED, CONTAMINATED, BADLY BURNT ON O.D. & I.D. ALSO RUSTY, PITTED & TELFON IS OVER LAPPING INTO PORT.
- ⑤ VALVE HOUSING - FILTER PORT ID HAS BURRS ON BOTTOM.
- ⑥ SPRING - NO DEFECTS NOTED.

B. OXIDIZER VALVE PIN 407559 SIN 4057735

- ① ARMATURE BALL - SLIGHTLY DISCOLORED & CONTAMINATED
- ② ARMATURE BALL RETAINER SLIGHTLY WORN
- ③ ARMATURE O.D. IS SCRATCHED & PITTED
- ④ TELFON SEAT IS OVER LAPPING INTO PORT ALSO PITTED
- ⑤ FILTER - IS CONTAMINATED ALSO RUSTY
- ⑥ SPRING - NO DEFECTS NOTED
- ⑦ VALVE HOUSING - BADLY CONTAMINATED, RUSTY & BURRS IN FILTER PORT.

PREPARED BY D. Cole	DATE	PERFORMED BY <i>[Signature]</i>	DATE	WITNESSED FOR NAA <i>[Signature]</i>	DATE	CERTIFIED FOR McDONNELL WAIVED BY <i>[Signature]</i> 8/10/65	DATE
				VERIFIED BY USAF <i>[Signature]</i>		DATE 8/10/65	

FORM 608-B-39 NEW 6-63

Rev. C *[Signature]* Date 12-1-64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-265
MINIMUM INSTRUMENTATION REQUIRE- { NAA 208160-61
NAME OF TEST MENTS - HOT FIRE TESTS TEST NO. 208160-101 SHEET 358 OF 380

TABLE I

<u>MEASUREMENT</u>	<u>RANGE</u>	(3) <u>PRECISION</u>	(1) <u>RESPONSE</u> (SEC)	<u>RECORDER</u>
Main Thrust (4) (5) (6)	0-30 lb	B(+ 0.5%)	1 + .25	Null Balance
Main Thrust (2) (5) (6)	0-30 lb	Y**	0.001	Oscillograph
Oxidizer Inlet Pressure (4)	0-500 psig	C(+ 1.0%)	1 + .25	Null Balance
Oxidizer Inlet Pressure (4)	0-500 psig	Y**	0.001	Oscillograph
Fuel Inlet Pressure (4)	0-500 psig	C(+ 1.0%)	1 + .25	Null Balance
Fuel Inlet Pressure (4)	0-500 psig	Y**	0.001	Oscillograph
Oxidizer Flowmeter Temp. (5)	0-300 F	D(+ 5.0 F)		Null Balance
Oxidizer Inlet Temperature (5)	0-300 F	D(+ 5.0 F)		Null Balance
Fuel Flowmeter Temperature (5)	0-300 F	D(+ 5.0 F)		Null Balance
Fuel Inlet Temperature (5)	0-300 F	D(+ 5.0 F)		Null Balance
Oxidizer Flowrate (5)	0.15-0.50 gpm	B(+ 0.5%)*	1 + .25	Null Balance
Oxidizer Flowrate (5)	0-0.5 gpm	B(+ 0.5%)*	0.001	Oscillograph
Fuel Flowrate (5)	0.15-0.65 gpm	B(+ 0.5%)*	1 + .25	Null Balance
Fuel Flowrate (5)	0.0-0.65 gpm	B(+ 0.5%)*	0.001	Oscillograph
Oxidizer Valve Current	0-1.0 amp	Y	0.001	Oscillograph
Fuel Valve Current	0.10 amp	Y	0.001	Oscillograph
Oxidizer Valve Voltage	0-40 volts	Y**	0.001	Oscillograph
Fuel Valve Voltage	0-40 volts	Y**	0.001	Oscillograph
Local Ambient Pressure	21-40 in Hg	Y		Barometer
Environmental Pressure (Fins)	0.02-0.20 psia	C(+ 1.0%)	1 + .25	Null Balance
Environmental Pressure (Fins)	0.02-0.20 psia	C(+ 1.0%)	1 + .25	Null Balance
Environmental Pressure (Coarse)	0.02-15.0 psia	C(+ 1.0%)	1 + .25	Null Balance
Environmental Temperature	0-300 F	D(+ 5.0 F)		Null Balance
Combustion Chamber Exterior	0-1000 F	D(+ 20 F)		Null Balance
Wall Temperature (3 Places) (7)				

PREPARED BY: J. Ganger	DATE 9/29/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 9-29-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE 9-29-64
CHECKED BY: <i>[Signature]</i>	DATE 9-29-64				

FORM 600-B-44 NEW 6-63

REVISION A *[Signature]* DATED 10/27/64

Revision D *[Signature]* 11/2/64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-265
MINIMUM INSTRUMENTATION REQUIRE- { NAA 208160-61
NAME OF TEST MENTS - HOT FIRE TESTS TEST NO. 208160 SHEET 101 OF 380

**TABLE I
(cont'd)**

<u>MEASUREMENT</u>	<u>(1) RESPONSE (SEC)</u>	<u>RECORDER</u>
Start and Cutoff, Pip	0.001	Oscillograph and
Oscillograph Drive, Pip	1.0 Max	Time Sequence
DIGR Drive, Pip	1.0 Max	Time Sequence
	1.0 Max	Time Sequence

NOTES:

- (1) Response is defined as the time required for the measurement recording system to travel from zero to full scale.
- (2) Trace full scale deflection shall be 3.0 inch minimum.
- (3) Letters designate instrumentation precision category per RAO201-050.
- (4) Ranges shall be increased 100 per cent for DAT Duty Cycle to minimum duration (including Cape Cycle) and Burst Pressure Firing Tests.
- (5) A single measuring transducer may be utilized to satisfy the requirements of more than one "bit" of information under the following circumstances:
 - A) Signal of one parameter is split to satisfy the requirements for more than one type of recorder.
 - B) Transducer is physically located to satisfy the requirements of more than one parameter.
- (6) May be deleted for Cape Cycle Tests only.
- (7) May be deleted for Impulse Signal With Test only.

PREPARED BY: J. Ganger	DATE 9/29/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 9-29-64	APPROVED FOR McDONNELL: <i>[X]</i>	DATE
CHECKED BY: <i>[Signature]</i>	DATE				

FORM 608-B-38 NEW 6-63

REVISION A *[Signature]* DATED 10/28/64
Revision D *[Signature]* DATED 12/17/64

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY PART NO. { MAC 52-52701-265
MINIMUM INSTRUMENTATION REQUIRE- NAA 208160-61
NAME OF TEST MENTS - HOT FIRE TESTS TEST NO. 208160 SHEET 401 OF 359.1
380

**TABLE I
(cont'd)**

NOTES: (cont'd)

- * "B" precision is required only: 1) on the OSC when turbine type flowmeters are used; 2) on the DIGR when drag body type flowmeters are used. For drag body type flowmeters, a three-step transfer calibration shall be recorded on the oscillograph and DIGR at the following pre and post test bleed flowrates: 0.032, 0.043 and 0.053 lb/sec. The Osc. deflections at nominal test flowrates shall be 2.5 inches minimum. For turbine type flowmeters, the DIGR precision shall be "C (+ 1.0%)".
- ** Thrust:
Perform a pre test multi-step calibration and record on the oscillograph at the following simulated thrusts: 0, 1.5, 3, 6, 15, 24, 27, 30, 27, 24, 15, 6, 1, 1.5 and 0. This shall be followed by a pre and post test one-step calibration (verification).
- ** Inlet Pressures:
Perform a multi-step transfer calibration (referenced to the DIGR) and record on the oscillograph at the following inlet pressures + 25 psi; 150 and 250 psig, and test lock-up inlet pressure. A post test one-step transfer calibration shall be recorded at the test lock-up inlet pressure.
- ** Valve Voltages:
Perform a multi-step calibration and record on the oscillograph at the following voltages + 1 volt; 22, 30 and 26. A post test one-step calibration shall be recorded at 26 + 1 volt.
- *** Perform a pre and post test Chamber Pressure standardization and record on the oscillograph.

PREPARED BY: J. Ganger	DATE 9/29/64	APPROVED FOR NAA: <i>[Signature]</i>	DATE 9-29-64	APPROVED FOR McDONNELL: <i>[Signature]</i>	DATE <i>[Signature]</i>
CHECKED BY: <i>[Signature]</i>	DATE <i>[Signature]</i>				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TEST NO. 208160-401 SHEET 360 OF 380

Reference: MAC SCD 52-52701, Revision G, Sheet 101.3 & 101.4

TABLE II

Seq.	Approximate Start (Sec)	Phase End (Sec)	Number of Pulses	Pulse Period (Sec)	Pulse Duration (Sec)	Operating Time Per TCA (Sec)	Accum. Firing Time (Sec) (1)
1	0	15	36	0.417	0.031	1.116	17.116
2	15	24	1	—	4.20	4.2	21.316
3	24	30	4	1.50	0.690	2.76	24.076
4	30	11,034	27	407.	0.014	0.378	24.454
5	11,034	11,040	4	1.50	0.690	2.76	27.214
6	11,040	11,300	27	9.65	0.020	0.54	27.754
7	11,300	12,186	168	5.27	0.031	5.208	32.962
8	12,186	12,237	8	6.38	0.690	5.52	38.482
9	12,240	12,244	4	1.00	0.029	0.116	38.598
10	12,246	12,330	544	0.152	0.053	28.938	67.536
11	12,361	12,377	18	0.889	0.031	0.558	68.094
12	12,377	12,436	41	1.440	0.029	1.179	69.273
13	12,436	12,447	33	0.333	0.031	1.023	70.296
14	12,478	12,489	12	0.916	0.029	0.348	70.644
15	12,489	12,571	8	10.25	0.690	5.52	76.164
16	12,574	12,675	93	1.09	0.029	2.727	78.891
17	12,705	12,756	336	0.152	0.053	17.808	96.699
18	12,761	12,794	37	0.892	0.029	1.073	97.772
19	12,796	12,805	70	0.129	0.033	3.710	101.482
20	12,815	12,857	35	1.20	0.029	1.015	102.497

PREPARED BY: E. Adams	DATE 4/10/64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: 7/7/64	DATE 4/10/64	4-13-64			

FORM 608-3-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TEST NO. 208160-401 SHEET 361 OF 380

TABLE II (CONTINUED)

Seq.	Approximate Phase Start (Sec)	Phase End (Sec)	Number of Pulses	Pulse Period (Sec)	Pulse Duration (Sec)	Operating Time Per TCA (Sec)	Accum Firing Time (Sec) (1)
21	12,874	12,893	140	0.135	0.053	7.42	109.917
22	12,898	12,918	23	0.870	0.029	0.667	110.584
23	12,919	12,996	8	9.62	0.690	5.52	116.104
24	12,998	13,042	52	0.845	0.029	1.508	117.612
25	13,062	13,063	8	0.125	0.053	0.424	118.036 (2)
26	13,064	13,150	314	0.274	0.053	16.642	134.678
27	13,190	13,222	36	0.890	0.029	1.044	135.722
28	13,262	13,267	6	0.833	0.031	0.186	135.908
29	13,267	13,289	25	0.880	0.029	0.725	136.663
30	13,324	13,473	441	0.338	0.053	23.371	160.004 (3)

NOTES:

- (1) Includes ten (10) seconds calibration firing and six (6) seconds of simulated cape checkout.
- (2) The TCA shall demonstrate specification performance for an accumulated firing time, including calibration and simulated cape firings of 118 seconds. TCA skin temperature shall not exceed 550 °F.
- (3) The TCA shall demonstrate operation without catastrophic failure for an accumulative firing time of 160 seconds.
- (4) Tests to failure will be conducted by repeating the pulses subsequent to 118 seconds within specification to 160 seconds until failure occurs.

PREPARED BY: E. Adams	DATE 7-10-64	APPROVED FOR NAA:	DATE	APPROVED FOR McDONNELL:	DATE
CHECKED BY: <i>E. Adams</i>	DATE 8-5-64	<i>[Signature]</i> 8-4-64		<i>[Signature]</i>	

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DAT DUTY CYCLE TEST NO. 208160-401 SHEET 362 OF 380

TABLE II

NOTES:
(cont'd)

(4) Catastrophic chamber failure is defined as a condition in which further operation of the TCA would endanger the space craft or crew. Specifically it shall include:

- (a) Loss of the capability to stop propellant flow,
- (b) Any flow or leakage of propellants products of combustion at locations other than the TCA nozzle exit,
- (c) Temperature in excess of 700 F at any point on the TCA exterior wall.

NOTE:

Three temperature sensors shall be mounted on the exterior wall as shown in Figure 6. The average temperature is to be used only when 700 F is not exceed by the TCA.

PREPARED BY: E. Adams	DATE 4/10/64	APPROVED FOR NAA:	DATE 4-13-64	APPROVED FOR McDONNELL:	DATE
CHECKED BY: 7/17/64	DATE 4/17/64				

FORM 608-B-38 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE ELECTRICAL SCHEMATIC TEST NO. 208160-101 SHEET 368 OF 380

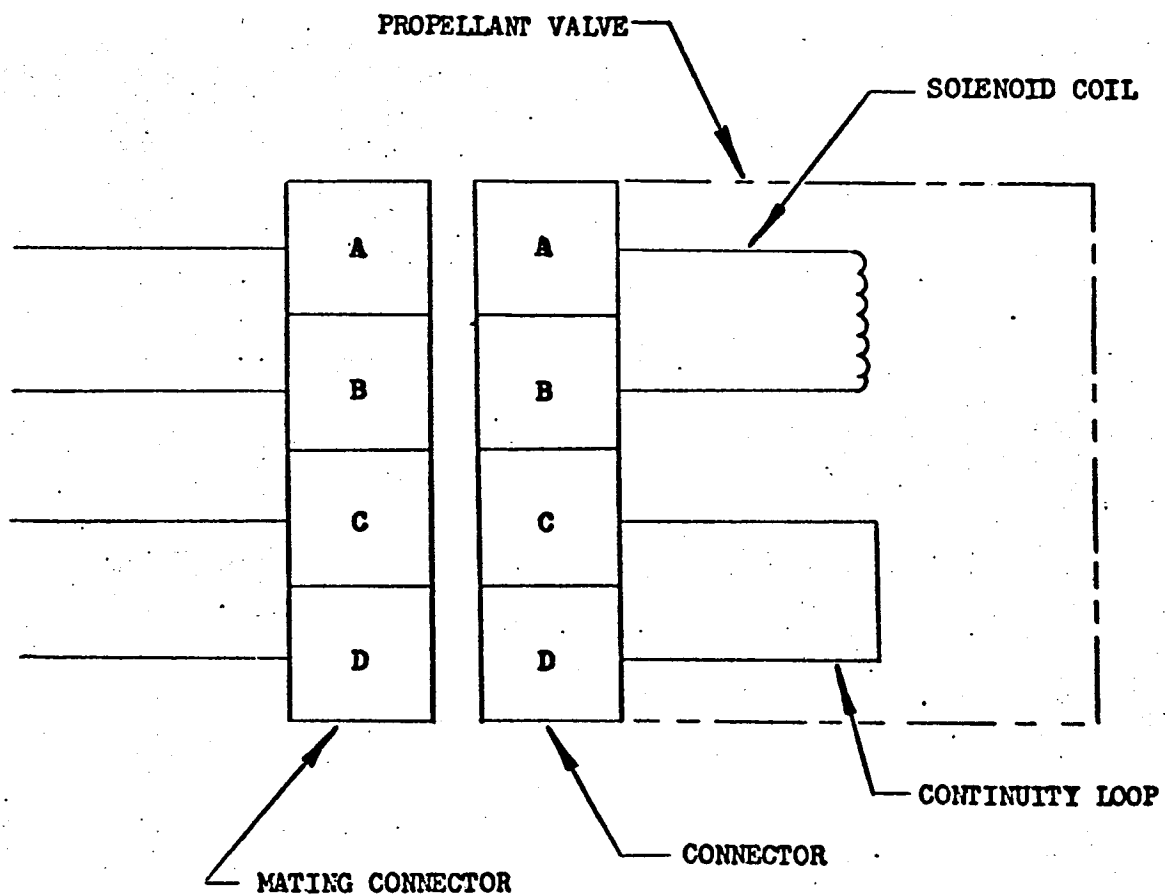


FIGURE 1

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
PROPELLANT VALVE PROOF PRESSURE { NAA 203160-61
NAME OF TEST AND LEAKAGE TEST NO. 203160-401 SHEET 369 OF 380

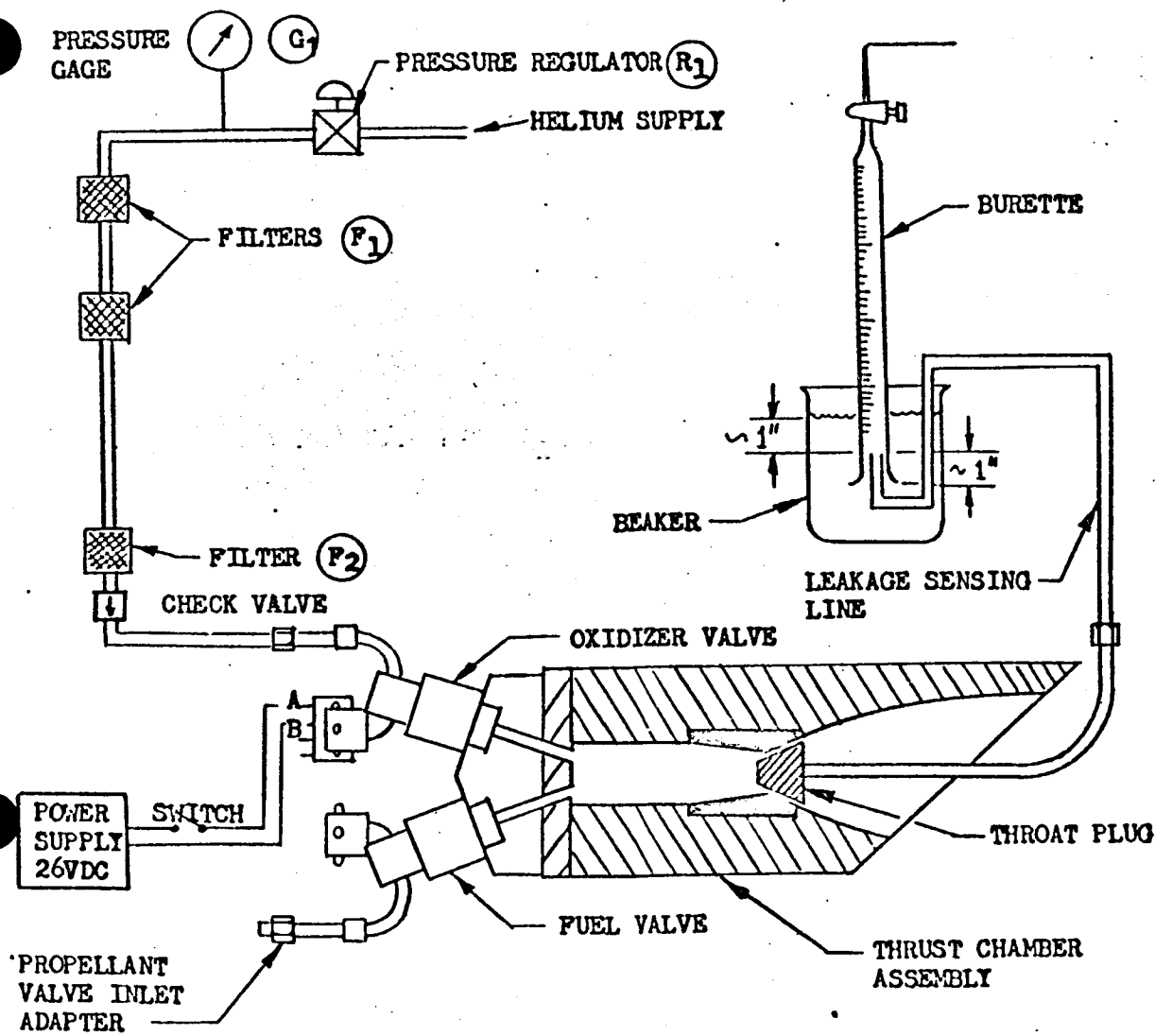


FIGURE 2

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY- 254 PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST THRUST CHAMBER PROOF PRESSURE TEST NO. 208160-401 SHEET 370 OF 380
AND LEAKAGE

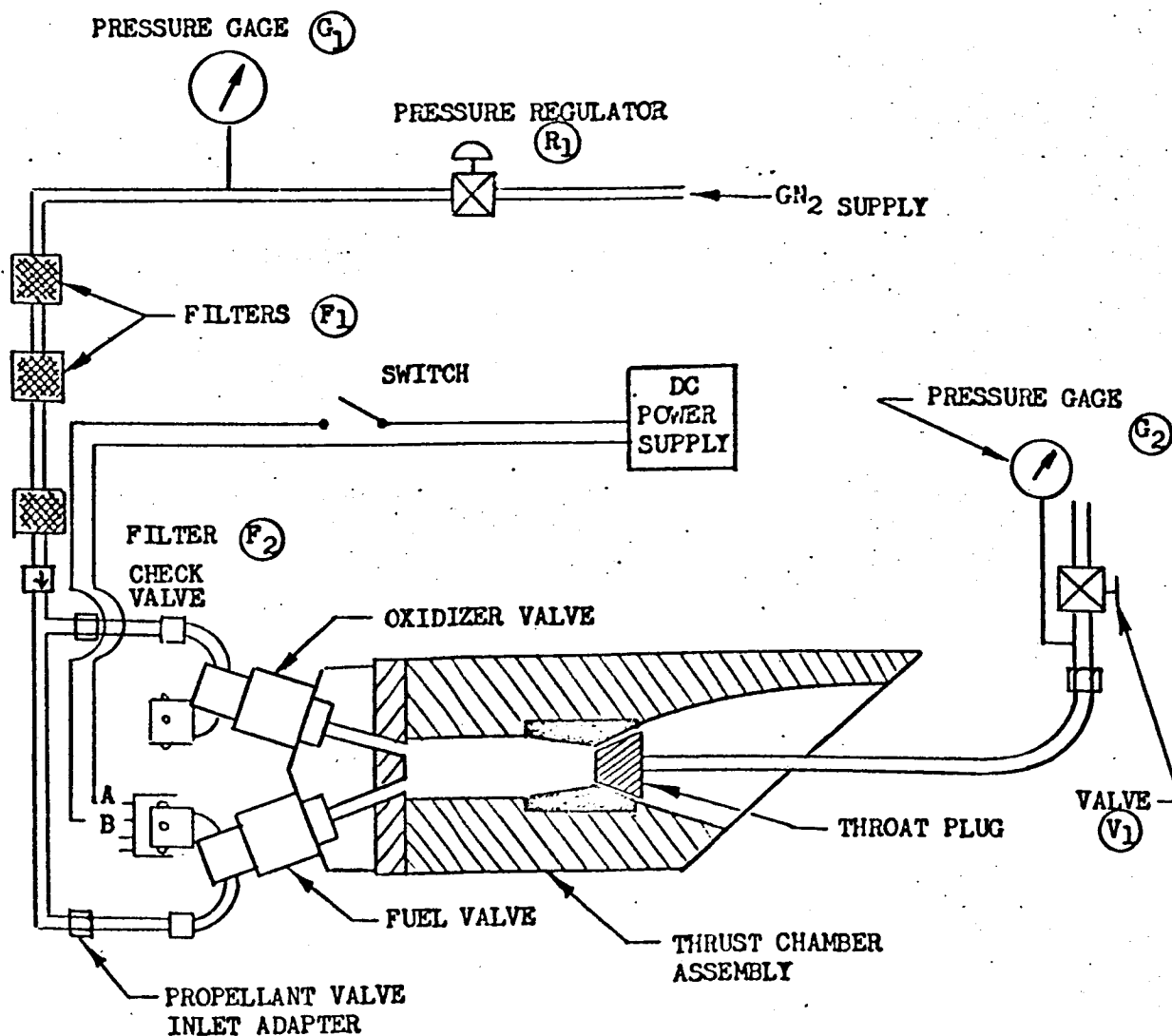


FIGURE 3

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE FUNCTIONAL TEST NO. 208160-401 SHEET 371 OF 380

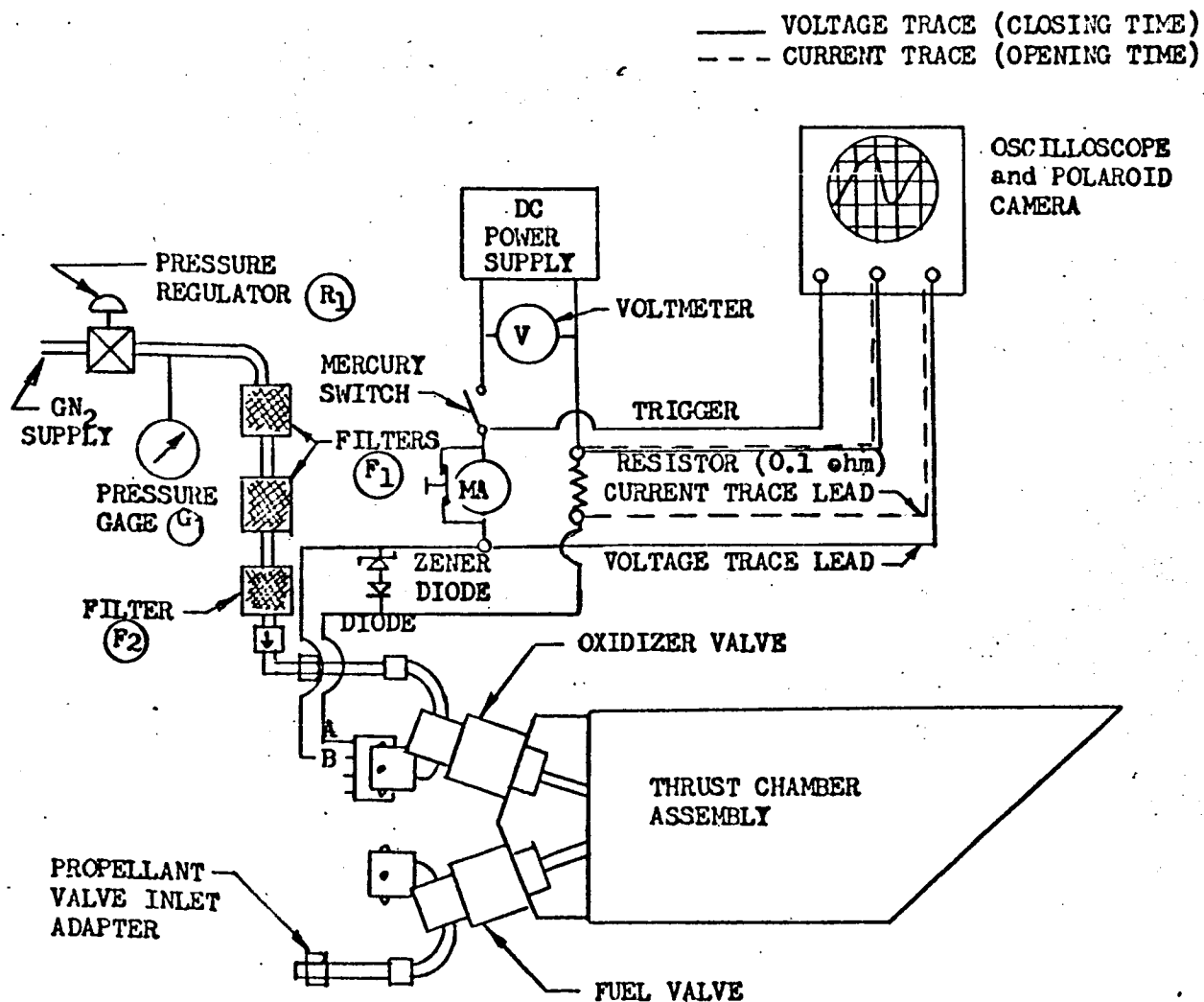


FIGURE 4

ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION, INC.

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**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
208160-101
NAME OF TEST PROPELLANT VALVE VOLTAGE AND CURRENT TRACES TEST NO. 208160-101 SHEET 372 OF 380

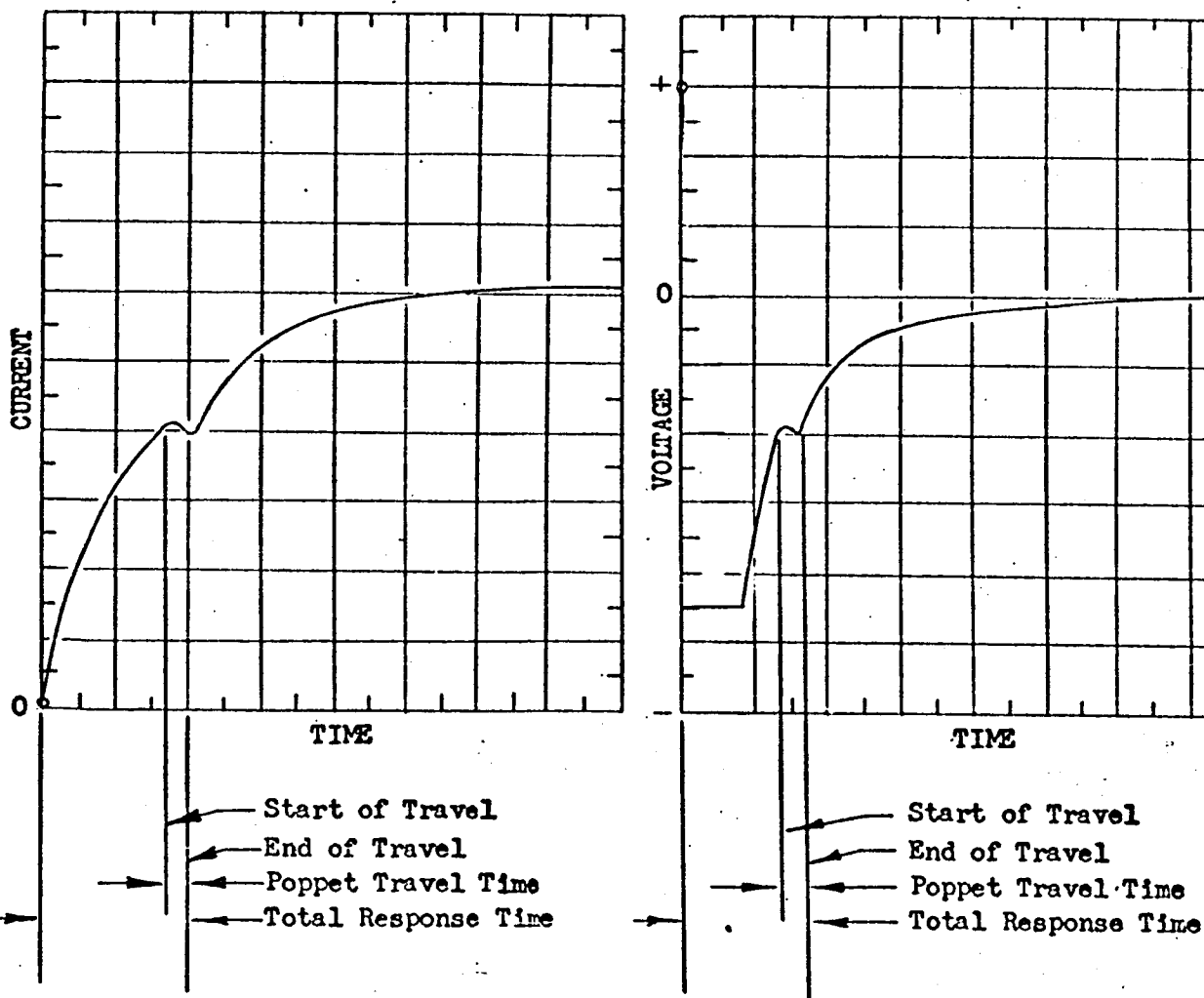
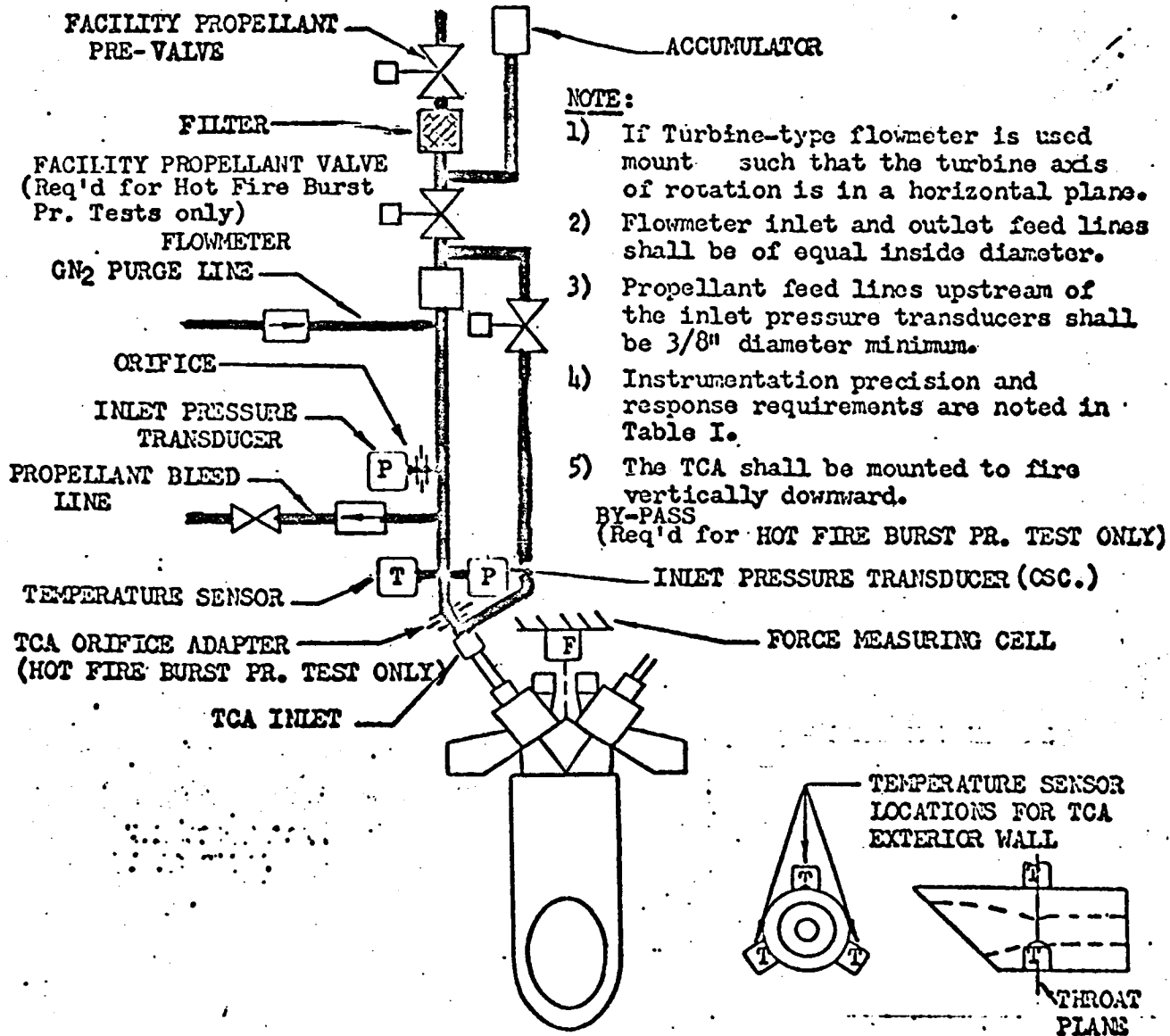


FIGURE 5

FORM 608-B-37 NEW 6-63

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT FEED SYSTEM TEST NO. 208160-701 SHEET 373 OF 380



FORM 608-B-37 NEW 6-63

REVISION B *D. R. [Signature]* DATED 10/28/64

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ROCKETDYNE
A DIVISION OF NORTH AMERICAN AVIATION INC

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST VIBRATION AND SHOCK TEST NO. 208160-101 SHEET 376 OF 380

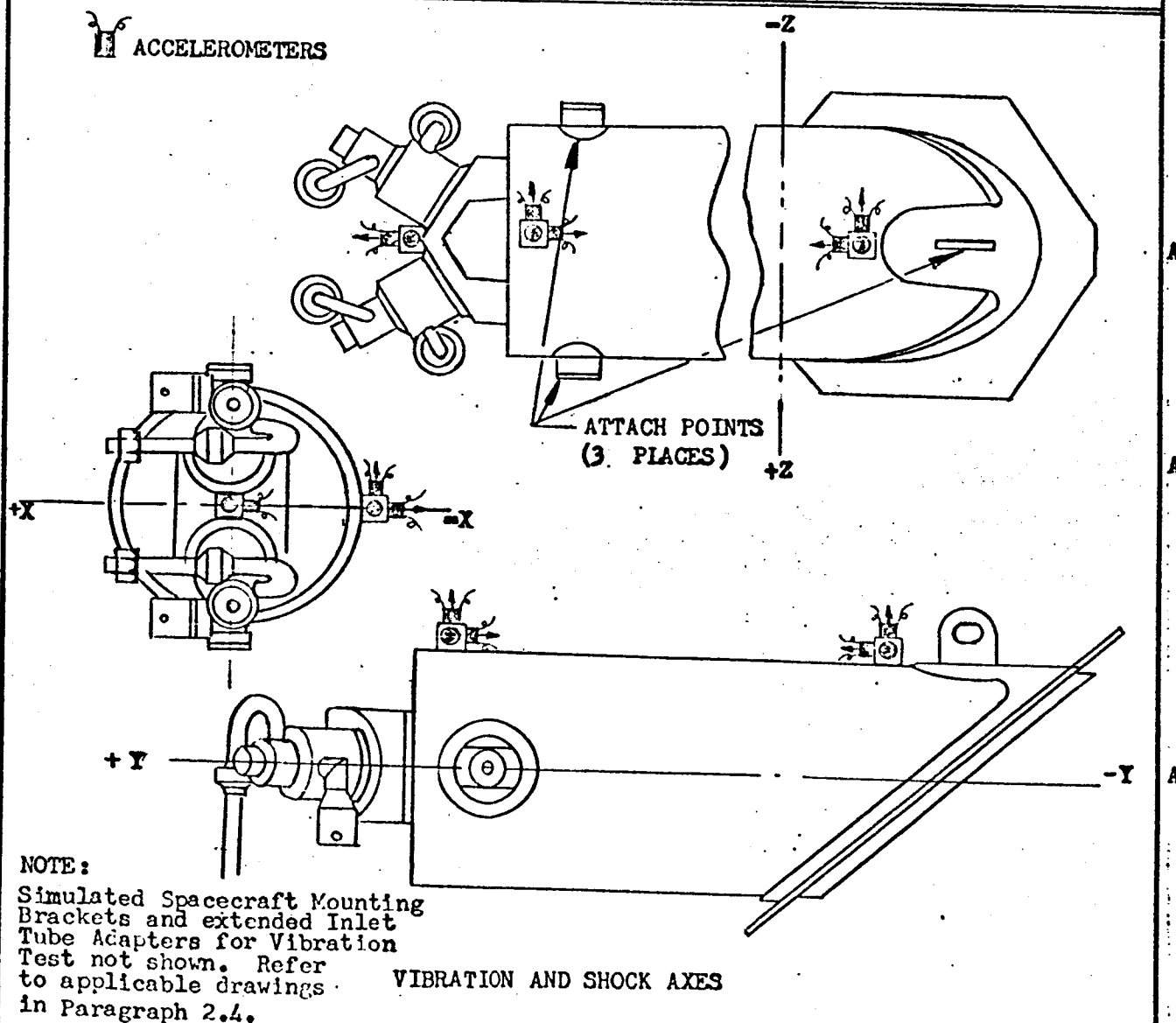


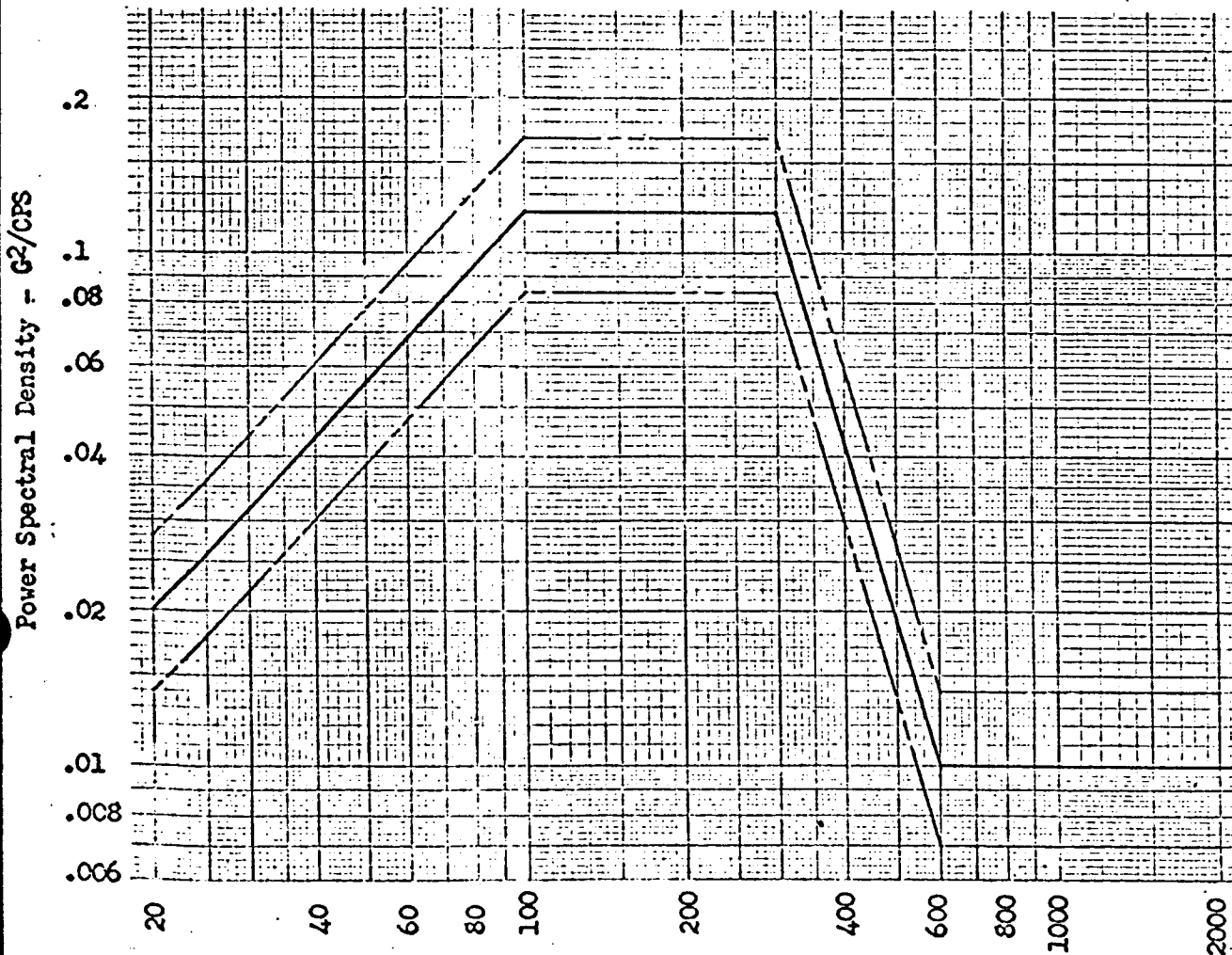
FIGURE 7

FORM 608-B-37 NEW 6-63

REVISION A *J.D. Morgan* Dated 8-3-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST RANDOM VIBRATION TEST NO. 208160-401 SHEET 377 OF 380



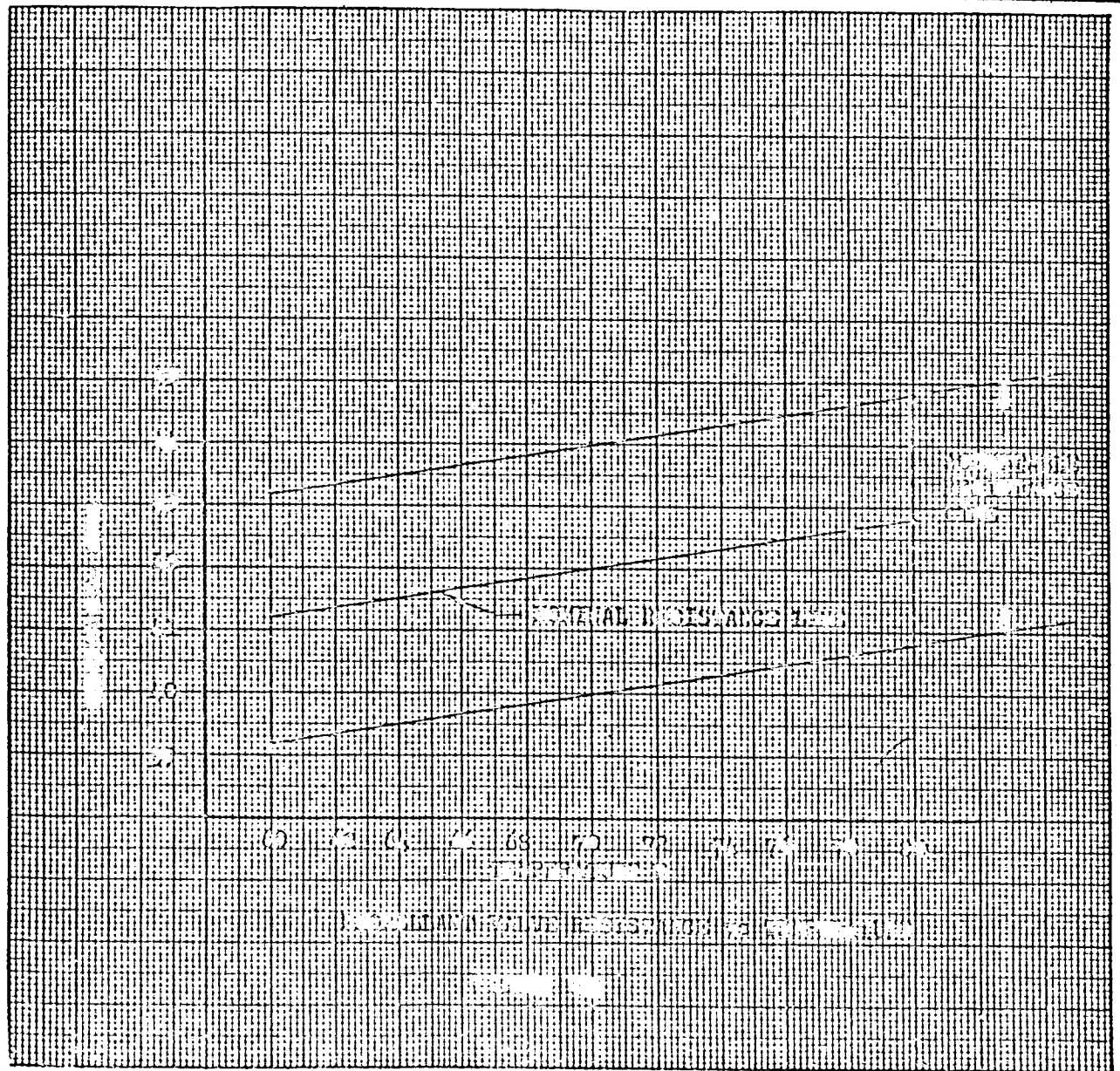
FORM 608-B-37 NEW 6-63

FREQUENCY - CPS

FIGURE 8

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY-25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE ELECTRICAL RESISTANCE TEST NO 208160-407 SHEET 378 OF 380



FORM 605-B-37 REV 6-63

ROCKETDYNE

A DIVISION OF NORTH AMERICAN AVIATION, INC.

DESIGN APPROVAL TEST OF COMPONENTS FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
401
NAME OF TEST THRUST PULSE PARAMETERS TEST NO. 208160-401 SHEET 379 OF 380

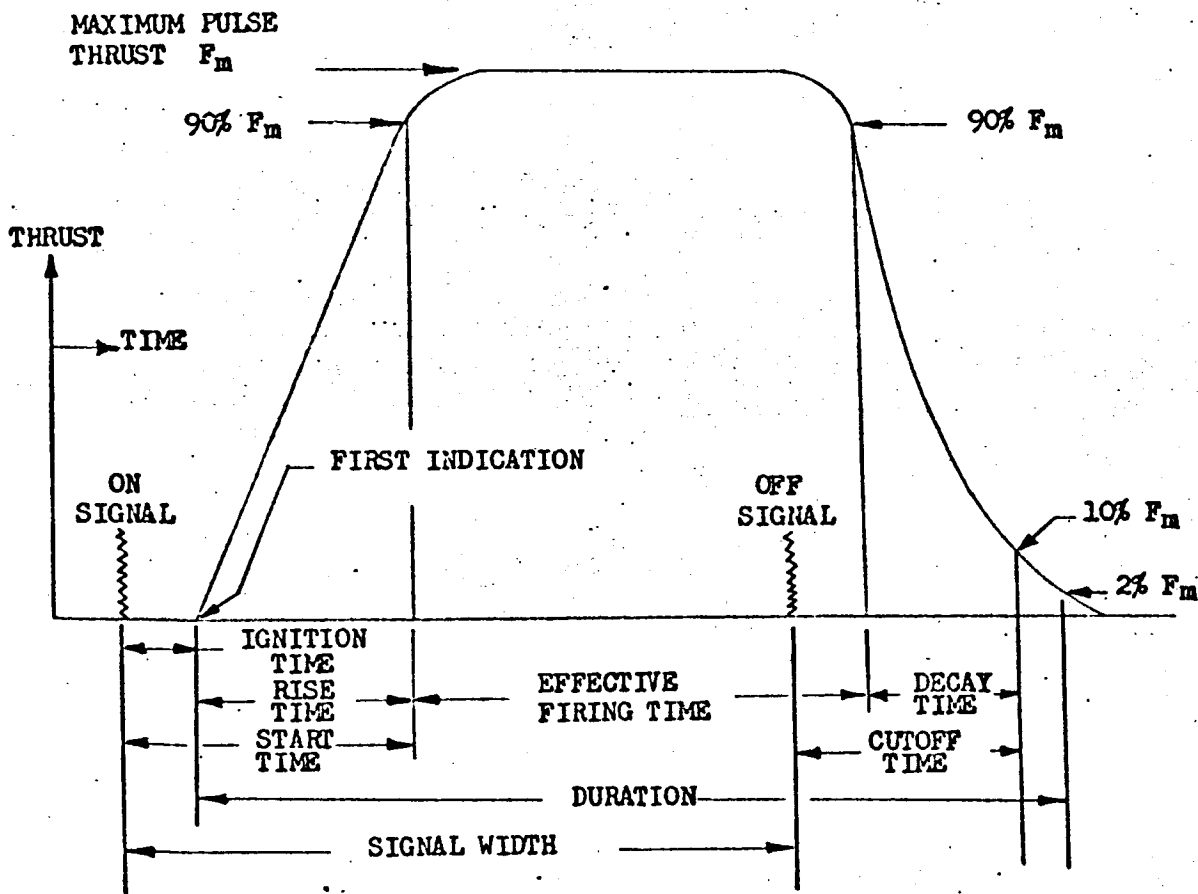


FIGURE 10

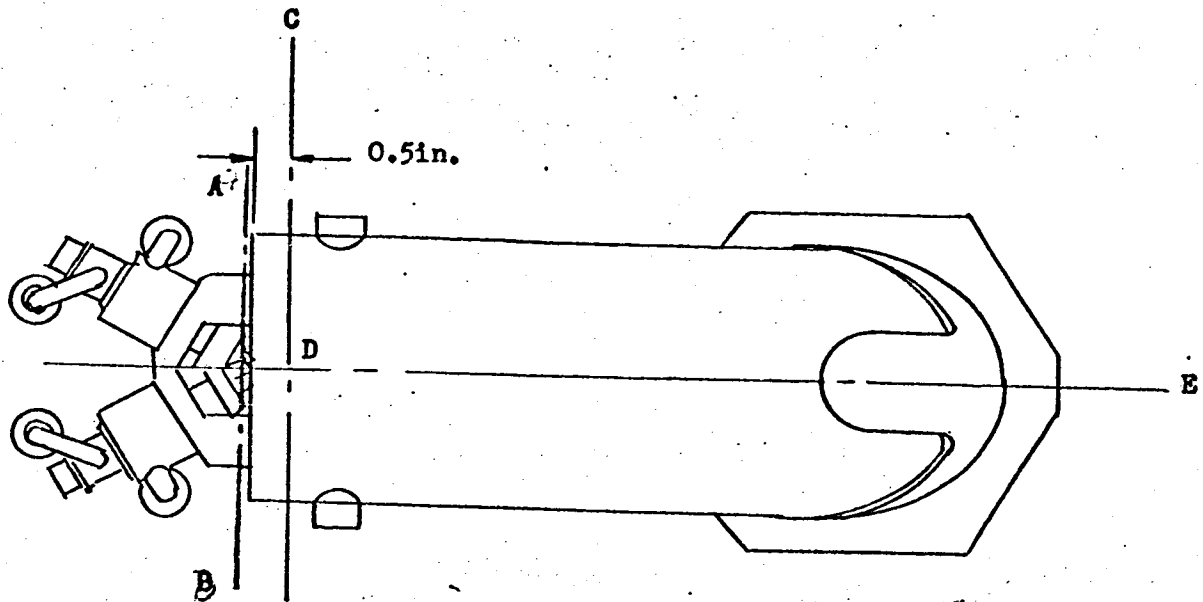
FORM 608-B-37 NEW 6-63

REVISION A

J. D. McCreary Dated 7-29-64

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY -25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST DISASSEMBLY AND INSPECTION TEST NO. 208160-701 SHEET 380 OF 380



SECTIONING DIAGRAM

FIGURE 11

FORM 608-B-37 NEW 6-63

Rev. C. D. Hargrave Date 11-20-64

R-15019-2

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST FUEL AND OXIDIZER RESISTANCE TEST NO. 208160-401-380.1 SHEET OF 380

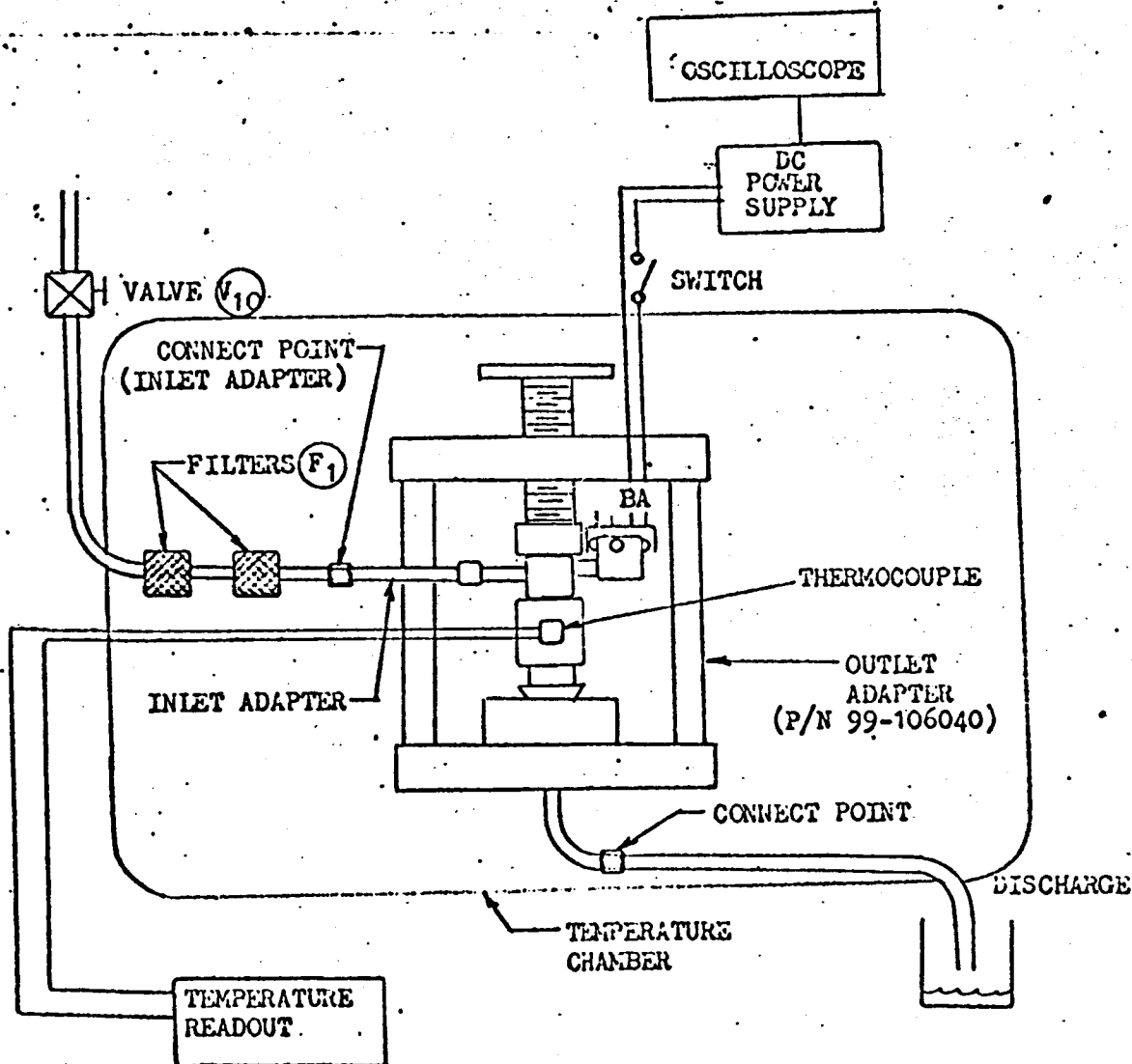


FIGURE 12

DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM

COMPONENT NAME THRUST CHAMBER ASSEMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST EXPLOSIVE ATMOSPHERE TEST NO. 208160-401 SHEET 380.2 OF 380

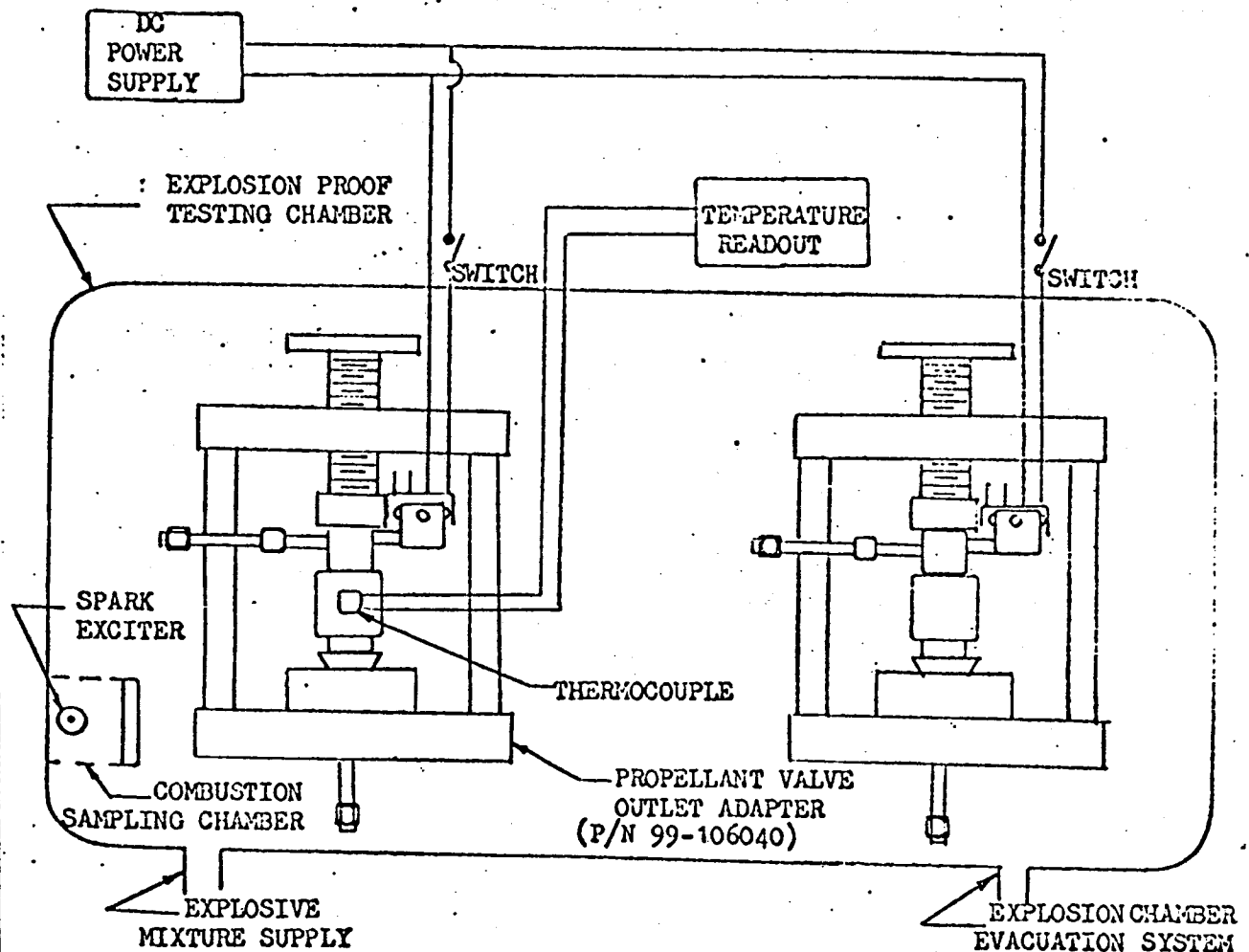


FIGURE 13

FORM 608-B-37 NEW 6-63

**DESIGN APPROVAL TEST OF COMPONENTS
FOR THE ORBIT ATTITUDE AND MANEUVER SYSTEM**

COMPONENT NAME THRUST CHAMBER ASSMBLY - 25# PART NO. { MAC 52-52701-265
NAA 208160-61
NAME OF TEST PROPELLANT VALVE LOAD ANALYSIS TEST NO. 208160-401 SHEET 380.3 OF 380

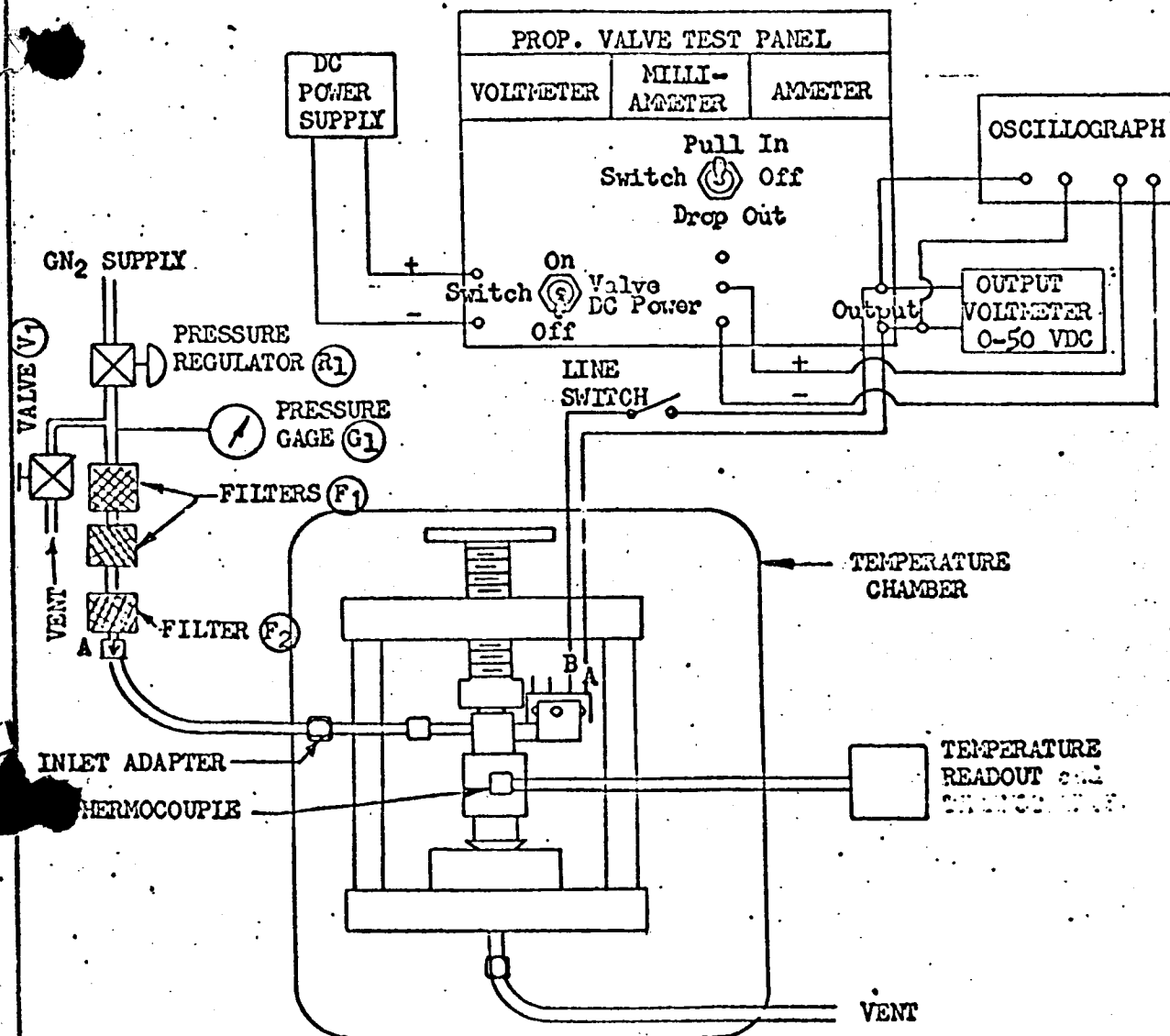


FIGURE 14